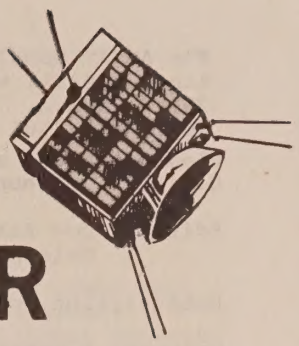
AMSAT™ NEWSLETTER



Publications Contest Winner 1977,1978

Issued quarterly by the Radio Amateur Satellite Corporation

Vol. XII Number 2 June 1979 $1.00

The AMSAT Newsletter is published quarterly by the Radio Amateur Satellite Corporation (AMSAT), with offices at 700 Seventh Street, S.W., Suite 224, Washington, D.C. 20024, U.S.A. Printed in the U.S.A. Second Class postage paid at Washington, D.C. (USPS 041-850)

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Subscription Price: $6.00 per year, inseparable from $10.00 membership dues.

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Copy Deadline for next issue is 1 August 1979

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COVER PICTURE

Marie Marr, AMSAT's Aerospace Technician, prepares AMSAT-OSCAR 7 for a solar simulation test. An artist's conception of this photo is available as a tee-shirt "iron-on" from AMSAT for $1.25, postpaid.

CONTENTS

Editorial.....3
Phase III Digital Telemetry.....4
Problems with RS.....13
Proposed Phase III Band Plan.....14
Proposed Phase III Bulletin Channel...22
Incurable OSCAR Fever.....29
Mode J Helix Antenna.....30
Satellite Communications Coverage Maps.....32
Recent Life Members.....34
Annual Meeting Announcement.....35
Election Information.....36
BALLOT FORM.....37
Letters and Comments.....38
Orbit Information.....39

BACK ISSUES AVAILABLE

Back issues of the Newsletter are available upon request in return for a donation to AMSAT.

If you specify what year you first joined AMSAT, we'll send you an assortment of ten earlier issues for $10.00, or fifteen issues for $15.00.

Certain pre-1974 and the September 1975 issues are not available.

Note that due to the time and effort involved in servicing back issue requests, the minimum donation should be $10.00.

Write to Back Issues, AMSAT, P.O. Box 27, Washington, D.C., 20044.

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EDITORIAL

By Joe Kasser G3ZCZ

A Change in Life Style

Having started as a local organization in Washingtcn, DC, just ten years ago, AMSAT is perhaps getting too large for our mostly volunteer workers to manage. The "Letters and Comments" column in these pages carry some of the dialogue between members and Headquarters. The enormous increase in membership and the new tasks undertaken by the few volunteers due to the complexity of the Phase III satellite means that changes are taking place. New volunteers are appearing and are having their creative energies fulfilled by all the load they can carry (and then some). Among the things that will involve us all are proposed changes in the Newsletter. The Newsletter, as it stands at the moment, serves a dual purpose. It provides information to the membership about current and proposed satellites and documents present-day events for posterity. It is a quarterly publication (improving with each issue, I hope) and, since it brings in zero advertising revenue, is a major expense in the AMSAT annual budget.

Several changes are proposed to the style, format and frequency of publication of this journal. In order to improve communications between the various AMSAT organizations in different parts of the world, it has been suggested that AMSAT organizations be requested to submit major (or entire) portions of an issue in camera-ready format in English, French, Spanish or German (with synopsis of article content in the other languages). It has been suggested that some articles be published bi or tri-lingually. It has been proposed that the Newsletter change its name, change to a 64 page 8½x11 inch format containing up to 50% advertising and appearing six or even twelve times a year. It has been suggested that its contents be expanded to provide coverage of all aspects of amateur radio/electronics in space--including EME propagation, signals from space, radio astronomy, satellites (AMSAT and others). It has been suggested that this expanded magazine be sold at radio and electronics stores. You, as a member of a democratic organization, have a voice in deciding which if any of these proposals be adopted by the Board of Directors.

At present, AMSAT is performing a study to determine if any of these suggestions are feasible. If they are, the Board will need direction from you as to their adoption. Are you satisfied with the Newsletter as it is? Would you like to see any changes? If so, what kind? Are you interested in contributing? No matter what its publication rate and style, the Newsletter will need authors. Almost any manuscript can be edited into shape. It does not need to be typed—it just needs to be readable. Why not consider writing something. In fact, you could even start with a letter to the Editor. If you have any comments or suggestions, put them down on paper and send them to me, c/o AMSAT, Box 27, Washington, DC 20044.

Elections

Once again it's election time. Reflecting our "internationality", we have candidates from three countries running for office. Four out of seven positions on the board are up for election this October. Are you satisfied with the way the organization is being run or are you not? Your ballot could be a vote of confidence to the three directors running for re-election, or a warning to new members of the Board. We are a democratic organization. Minutes of Board meetings are published for your information. You have the right and the responsibility to vote. It is a pity that none of the nominees provided any input as to why they should be elected and what changes they would make to the organization. They did supply some information about their present and past activities in AMSAT and Amateur Radio. Peruse their qualifications and vote. Vote now, before you forget. See the ballot in this issue.

DIGITAL COMMUNICATION TECHNIQUES AND THE AMSAT PHASE III SATELLITES

By Karl Meinzer, DJ4ZC*

Digital transmission systems have always been in use by radio amateurs - the expression "digital" means nothing more than that on/off states are being transmitted. Morse code communication is an example of a digital transmission medium. Later, amplitude modulation techniques were discovered and it became possible to transmit speech and video. The introduction of SSB and FM to the amateur radio service has channelled most of the interest towards voice communications. Now that low cost computers are available it is expected that the use of digital communications techniques will increase. These new developments and techniques will be described using the AMSAT Phase III project as an example.

Until now, most digital transmission systems have been limited by the construction of the "receivers." The CW technique is designed in such a way that the human ear and brain act as the receiver. In RTTY, a machine is used as the receiver and data transmission techniques had to take into account the capabilities of teletype machines. Independently, scientists have performed studies to find out what one could expect from an optimized system and how efficient current systems are. Perhaps the most important contribution along these lines was published in 1948 by Shannon in his "Information Theory of Communication". For our study, we can condense his findings as follows:

1. All information can be characterized by the number of bits, independent of its type or importance to the receiver. (A bit is a "zero"/"one" decision.)

2. The transmission of information must consider the frequency of each character. For instance, in CW the letters used more often use fewer dits or dahs, e.g., the letter 'e' uses fewer bits than the letter 'h'. This process is called the encoding of information.

3. Each information channel, as limited by its signal-to-noise ratio and its bandwidth, has an upper theoretical information capacity (C = bits/second) which cannot be exceeded. It is given by the equation $C = B \log_2(1 + S/N_oB)$, where B = bandwidth, S = signal strength and N_o = noise level per cycle bandwidth. It has been found that many systems in current use are working 30 dB below their theoretical optimum value.

The results of the work performed by Shannon have been slow to find their way into practical systems. It points out the potentials of a system based on probability theory reasoning, but it does not give practical advice for construction of such systems. In actual fact, three additional problems had to be resolved in order to be able to achieve practical performance near Shannon's theoretical limits.

First:

A suitable encoding system had to be found which permits the almost errorless construction of a message, even if errors occur during the transmission of single bits. This is only possible if more bits are transmitted then are actually contained in the message. For instance, to transmit voice, one often resorts to the use of a phonetic alphabet for each letter. This permits the person receiving the message to reconstruct it even while interference is present. This additional information is commonly referred to as redundant information.

At first, it may appear surprising that using "excess" or redundant information will improve the channel performance because the redundant data requires additional channel capacity (for instance, bandwidth) and thus degrades the signal-to-noise ratio. A detailed analysis, however shows that the advantages afforded by redundancy may exceed the disadvantages of the greater bandwidth requirement.

Second:

The encoded signal must be transmitted over radio frequencies. It is by no means obvious which modulation and demodulation system would yield the best results. The concept of "matched filters" points to a solution. The basic idea is that with the transmission of each individual bit, the receiver need only decide whether a "1" or a "0" was transmitted. Everything else, such as the beginning or end of the bit or the exact frequency is assumed to be known. Most practical systems in use today also extract this information from the data stream. This, however degrades the system performance.

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*Translated from the original German in CQ-DL, October 1978, by Fred Siebert, K3PNL.

An optimal information system uses two filters whose passbands correspond to the signal spectra (that is where the name, "matched filters" is derived from). One filter passes the signal transmitted during a zero; the other filter passes the signal of the 1. It is assumed that the two signal spectra do not overlap and that each filter only responds to the respective transmitted state. (This condition is referred to as "orthogonality" and resulted in the origination of the phrase "orthogonal transmission system".) During a bit duration, the receiver "observes" both filter outputs, and at the end of the bit decides which of the two outputs was larger on the average, and thus, whether a "0" bit or "1" was transmitted. This technique is used in the common RTTY demodulator circuits in the ST-5 and 6 series.

A consequent application of the principle just described also implies that the phase of the signal is known. The keying can then be accomplished by changing the phase of the carrier (for instance by ± 90 degrees). It can be shown that phase-shift keying (PSK) is the best possible method if white noise is the sole transmission interference. This is the general situation in the case of satellite communication links.

Third:

Using optimally matched filters also implies that the design of the transmitted signal is dictated solely by communication constraints without regard to the final "receiver" requirements. This means that the received signal must usually be processed before it is useful. Typically, an optimal system employs a steady flow of data, with all bits lasting the same amount of time. This is called "synchronous transmission". Most technical equipment, however, operates asynchronously, for instance, a teletype machine expects bits only when a letter is being transmitted. Generally, synchronous transmission formats require the use of computers to process the data.

The process described was used extensively by the "Mariner" space probes to Mars and Venus, and contributed to the tremendous success of the mission. At the same time, they have also shown that a considerable effort is required to implement these techniques.

The AMSAT Phase III satellites will employ an on-board computer mainly for attitude stabilization and other functions. In order to perform the different tasks within the satellite, the computer must be re-programmable by ground command. This requires a digital communications link between ground stations and the satellite. In the development of the Phase III communication system, the guideline was to use as much of the experience gained from the Mariner space mission as possible, but at the same time to omit the ultimate fine-structure so as to keep the project within the capabilities of radio amateurs. Even with simplified techniques, it was found that it was possible to obtain near optimum results. Despite the low power of the satellite beacons, a sufficiently fast data rate can be accomplished for the computer.

Studies of the link capabilities between satellite and ground indicated that a data rate limit of 500 bits/second was the optimum level. Thus,we have chosen a data rate of 400 bits/second for the simple reason that the computer contains an internal 20 millisecond clock for different time-keeping functions (for instance, for RTTY telemetry). This means that every 20 milliseconds, one byte must be generated (a byte contains 8 bits; it is the basic unit being processed by the computer). Thus, a data rate of 400 bits/second results. Naturally, the single clock rate simplifies the rest of the on-board electronic circuitry.

Up to now, radio amateurs have relied mainly upon frequency-shift keying (FSK) or CW for digital transmission systems.

Figure 1 shows error rates which can be expected with various methods and signal-to-noise ratios. Since we are aiming for a bit error rate of 1 in 10^{-5}, we find that synchronous FSK is 4 dB worse than phase-shift keying (PSK); with PSK and so-called convolutional coding, it is possible to obtain an additional improvement of more than 5 dB.

For amateur satellite use, uncoded PSK was selected because this signal will fit within the SSB bandwidth of 2 kHz. FSK and coded PSK would have required a wider bandwidth.

Uncoded PSK permits the use of readily available SSB equipment. Only the addition of an auxiliary audio frequency converter is required for the demodulation process, much in the same way as an RTTY TU is required to demodulate teletype signals.

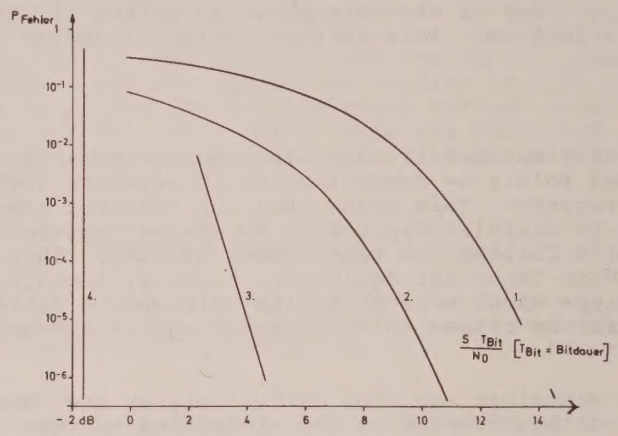
FIG. 1: Error rates for synchronous orthogonal transmission systems employing matched filters.

T_{BIT} = bit duration

P_{Fehler} = Error rate

Notes

1. FSK (curve is not valid for asynchronous FSK as transmitted via RTTY)
2. PSK ($\pm 90^{o}$)
3. PSK ($\pm 90^{o}$), convolutionally encoded 8 bits, data rate is ½ the bit rate, Viterbi decoder
4. Shannon Limits, $B \rightarrow \infty$



Should the link between satellite and ground deteriorate for any reason, it is possible for the computer to generate a convolutional encoded signal at half the data rate by means of software. This will improve the link by some 6 dB, but because of the slower data rate, greater software complexity and increased stability requirements result,and this change would be used only in an emergency.

As already mentioned, the concept of optimal transmission systems requires full knowledge of the characteristics of the signals, except whether a "0" or "1" has been transmitted. In particular, it requires the reconstruction of not only the carrier frequency, but also its phase, by the ground station, in order to enable the signal to be demodulated. This means that ground equipment must have sufficient frequency stability to maintain a constant phase over a period of several bits. Since the reference phase is reconstructed by means of a phase-locked loop (PLL) circuit, long-term frequency variations present no problems.

Measurements have proven that common UHF-SSB sets are still sufficiently stable at 400 bits/second, but much slower data rates cannot be handled. Using coded PSK, such a narrow bandwidth is required for the carrier reconstruction that manual tuning becomes very difficult. This is one more reason against the use of coded PSK.

The demodulation process also requires knowledge of the bit rate and phase in order to determine when a bit begins and when it ends. In addition, it is also necessary to know when the start of each byte consisting of 8 bits and the start of a whole data block occur. All this information must be extracted from the data stream without examination of individual bits. Otherwise, this would constitute a break of the rule of only extracting the "0" or "1" decision from each individual bit.

The fact that the data stream occurs at a known periodic rate is used to derive the necessary timing information. By observing the signal for a period of time much longer than the duration of an individual bit, an estimate of the time information can be derived. This of course assumes that the signal implicitly contains this information. Long-time signal integration permits the reduction of uncertainties caused by noise.

Let us now investigate in detail the Phase III telemetry format. In order to be able to recover the bit rate, the signal must contain a sufficient number of "0" and "1" transitions. This, of course, is not possible if the data consists of a string of continuous "0's". To resolve this problem, the individual bits are gated with a data clock in an exclusive "or" gate circuit. (Fig. 2). This places a polarity change at the center of each bit time. This will not deteriorate the transmission characteristics if it is accounted for by the demodulation process. This procedure is called bi-phase encoding.

At the transmitter end, the phase is shifted ±90 degrees by the keying signal. The amplitudes of the sidebands gradually decrease as the distance from the carrier is increased in a normal PSK system. AMSAT thus limits the bandwidth to 3 kHz to prevent interference to adjacent channels. A balanced modulator is employed for keying instead of a phase modulator; the output is fed through a low-pass filter. Thus the amplitude of the transmitted signal varies slightly with time. This is of little consequence to the performance of the system.

Because of the bi-phase encoding, each bit contains a "0" and "1" period of equal duration, and thus no carrier is present on the average. This is an advantage as far as energy usage is concerned because, as with SSB, the carrier contains no information. On the other hand, this presents a problem because it becomes more difficult to recover the carrier for the demodulation.

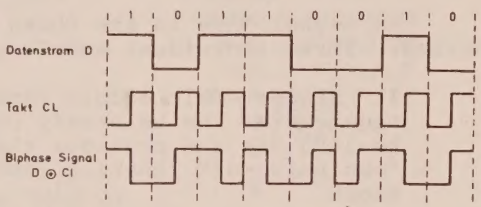
To regenerate the carrier, a unique circuit is employed. If one takes a signal which changes phase between 0 and 180 degrees, and doubles it in frequency, a signal is obtained which varies between 0 and 360 degrees. Since 360 degrees is equivalent to 0 degrees, a signal has been generated at twice the carrier frequency. The carrier frequency can then be obtained by means of a frequency divider circuit. Unfortunately, there will still be a phase ambiguity of 180 degrees.

This problem can be corrected in a number of ways. (Otherwise, the "0" and "1" output could be transposed.) One can either employ some knowledge about the data and make a decision as to whether the proper format or its inverse format is present. A second technique, which was selected for the Phase III satellite, simply lives with the uncertainty: the transmitted bit is not used as the data bit; rather,the difference between the last two transmitted bits is defined as the data bit. If the two bits were equal, a "0" was transmitted; otherwise a "1" was transmitted. It is easy to see that now the polarity of the transmitted signal is no longer important.

FIG. 2: Bi-phase encoding of digital data

Datenstrom D = data stream D

Takt CL = Clock pulse



A second uncertainty exists in the recovery of the bit-rate. If an uninterrupted series of "0's" or "1's" are transmitted, then each bit has two polarity changes. In this case, the receiver is unable to determine whether a string of "0's" or of "1's"-shifted 180 degrees-was transmitted. The decision can only be made if a sufficient number of transmitions between "0" and "1" take place. Thus, more polarity changes take place in the middle of the bit as compared to the bit-boundaries. This fact is used in the decision-making process regarding the bit phase. The data rate is obtained similiarly to the carrier frequency: by doubling and a later division.

Up to now, nothing has been said about the data format. Our computer software uses data blocks of 512 bytes (4096 bits). Telemetry data is transmitted in the same format. Generally, ASCII-characters constitute the data-content. Each character has 8 bits. (These 8-bit characters are also called "bytes".) A data block has 8 lines, each with 64 characters. It is characteristic of synchronous data formats to always transmit complete data blocks, even if the message contains only a few words. In this condition, blanks are inserted to fill the data block.

As already mentioned, in a synchronous system a continuous flow of bits is transmitted. If at a particular instant no data information is available for transmission, the bit string 01010000 is sent repetitively. Each 8-bit byte can be abbreviated, when manually writing it, to two hexadecimal digits, with the letters A through F substituted for the numbers 10 through 15. Thus, the count goes 0, 1... ...8, 9, A, B..E, F. Thus the figure 50 (Hex) denotes the filler byte and the "5" is the most significant digit and is sent first.

Four bytes are used to indicate the start of a data block. The sequence: 39, 19, ED, 30 is called the sync-vector block. It is a pseudo-random sequence and can be easily recognized using a 5-bit shift register. The sync-vector is followed by 512 bytes of data. (Optionally, 4 additional bytes may be appended. This is not done regularly, though.) After that follows a series of "50"'s until the next block is ready to be transmitted. As a rule, the contents of the data blocks are clear text consisting of ASCII characters. The text from the Phase III satellite telemetry will be readily readable without any additional information. During the initial launch and checkout phase during which time extensive command traffic takes place some background information may be needed, though. This background information will be described in greater detail in a later AMSAT newsletter.

A continuous stream of data blocks containing telemetry will be transmitted. Between each data blocks "50"'s are sent for a period of 2.5 seconds. If commands are being sent to the satellite, then command acknowledgment blocks take the place of the regular telemetry.

The command traffic to the satellite follows a pattern similar to the telemetry. But the command blocks always contain check bits; in case of a transmission error, the entire command block will be rejected by the satellite. The satellite will then also send an error message. The command blocks are also constructed slightly differently in order to prevent unauthorized use of the system.

A third use of the 400 bit per second data system is planned. It is necessary to maintain accurate satellite orbital information for a number of reasons. This information could be obtained by measuring the angle between ground stations and the satellite, or else by measuring the distance between ground stations and the satellite. AMSAT has elected to use the distance-measuring method. With this method, a pseudo-random bit stream of 256 bits length is transmitted to the satellite. The satellite returns this bit stream via the transponder. The distance is calculated by measuring the time interval between the transmitted and returned information. This method permits a range measurement accuracy to within approximately ±5 kilometers.

On occasion, the measurement technique may be altered. In this case, the computer aboard the satellite generates the range sequence. Three ground stations receive and return the sequence. An additional station receives all three signals downlinked from the satellite and evaluates the distances. This method permits a determination of the satellite position using one measurement, and two such measurements taken consecutively a few minutes apart will provide total orbital information.

The signal flow in the Phase III telemetry ground equipment will now be described. Three individual modules are used for decoding (Figs. 3 through 8):

1. AFDEM: This module receives the audio signal from the SSB receiver. It regenerates the telemetry carrier (down-converted by the SSB receiver to 1200 to 1600 Hz) and provides the data stream with the data rate through the "exclusive-or" function (D⊕C1) where D is the data bit stream and C1 is the clock.

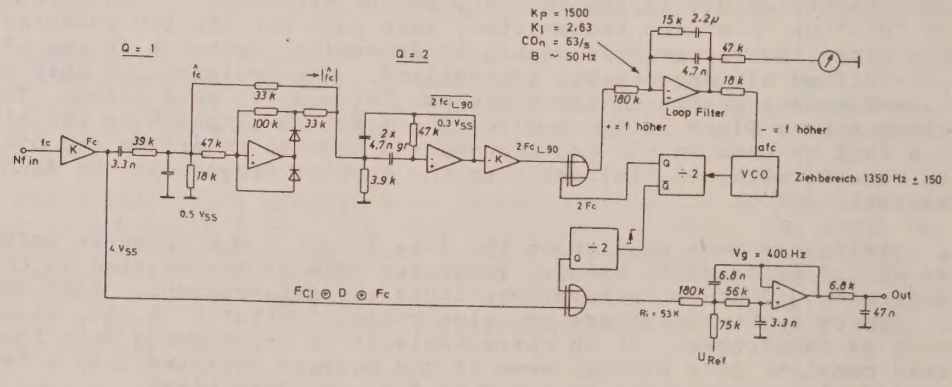


FIG. 3: AFDEM

Ziehbereich 1350 Hz ±150 = lock-in range 1350 ±150 Hz

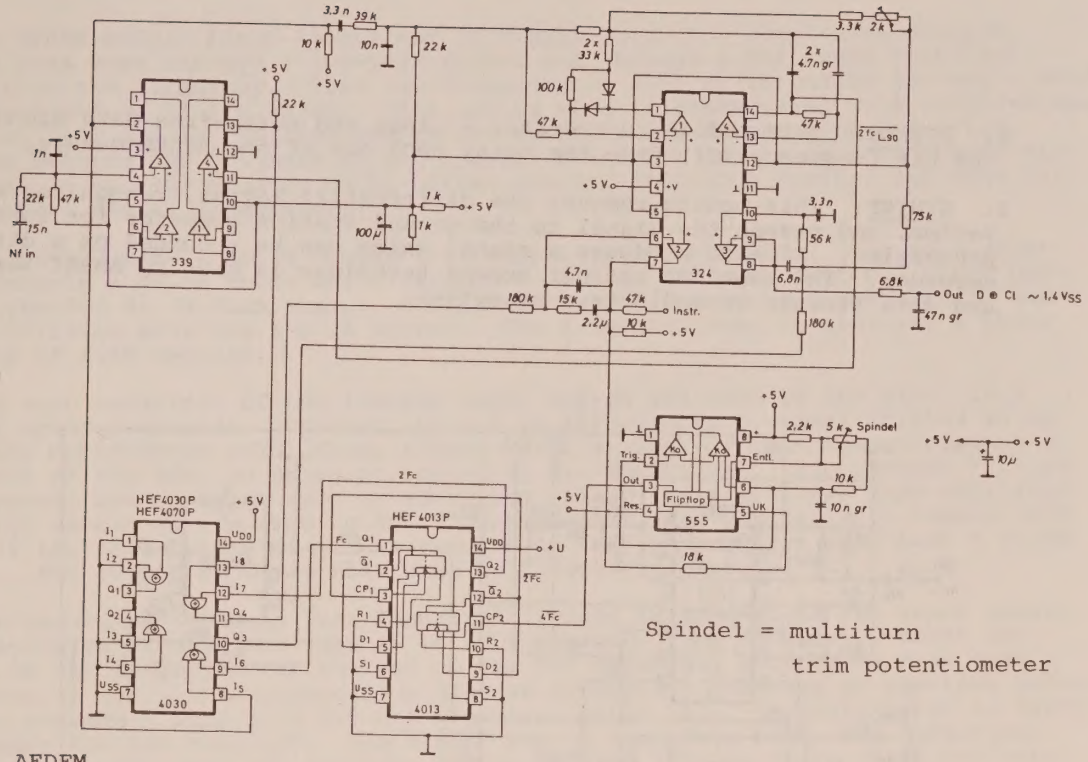


FIG. 4: AFDEM

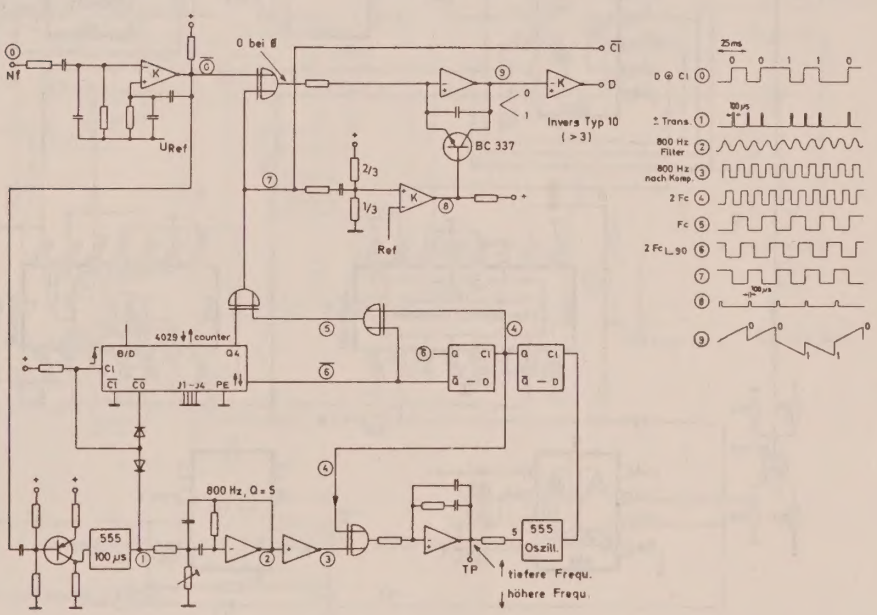


FIG. 5: Bitreg

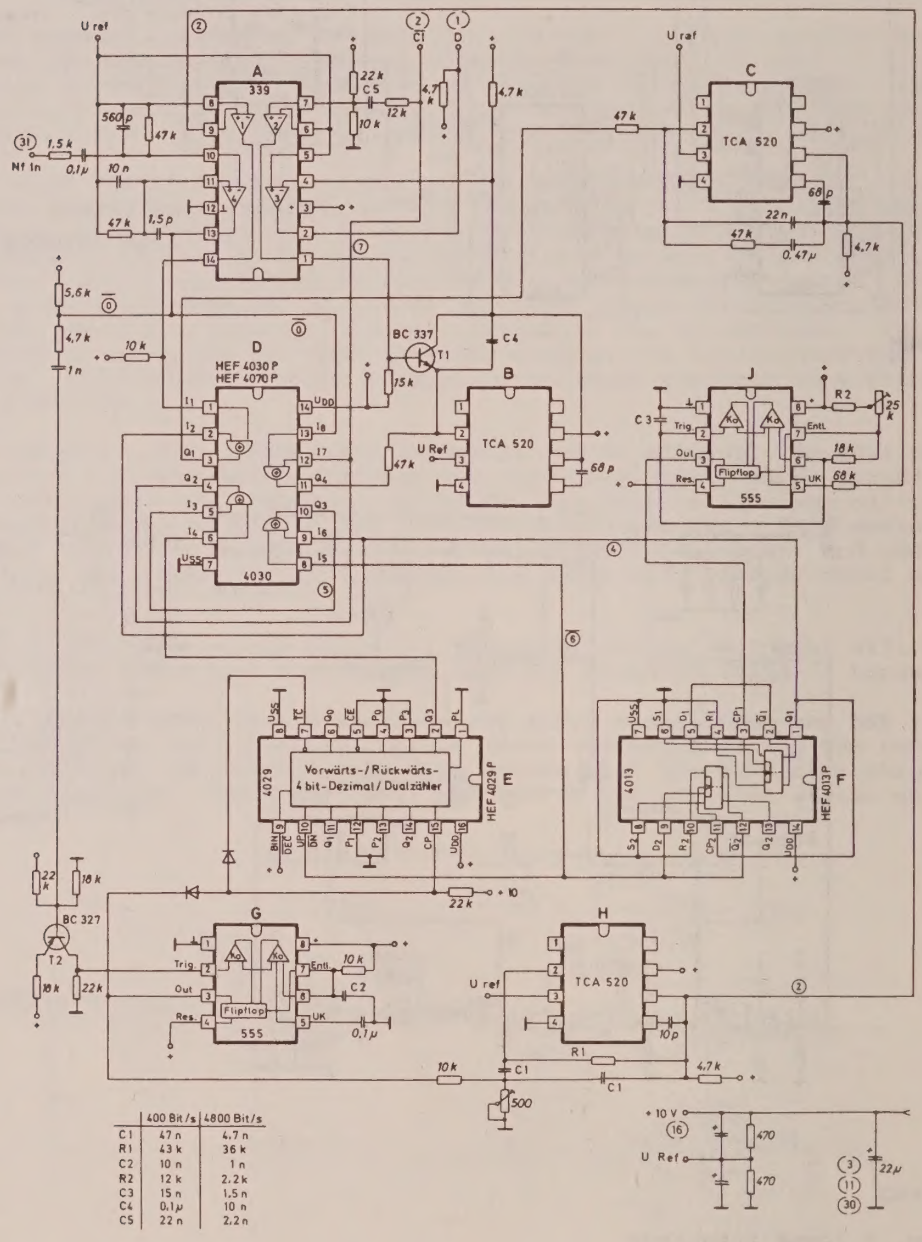
tiefere Frequ. = lower frequency

höhere Frequ. = higher frequency

Invers Typ 10 (> 3) = Transistor with inverse β = 10(> 3)

2. BITREG: This module regenerates a clean and noise-free data signal and the bit frequency (C1) from the noisy D⊕C1 out of the AFDEM module.

3. SYNINF: This module removes the differential keying, recognizes the sync vector, and passes the signal to the ground station computer for further processing. It also produces a signal which can be recorded on a cassette recorder. The same 400 bit per second technique is used by AMSAT for program and data storage on audio tape cassettes.



	400 Bit/s	4800 Bit/s
C1	47 n	4.7 n
R1	43 k	36 k
C2	10 n	1 n
R2	12 k	2.2 k
C3	15 n	1.5 n
C4	0.1 µ	10 n
C5	22 n	2.2 n

FIG. 6: BITREG

Vorwärts - /Rückwärts = Up-down counter

4 bit - Dezimal/Dualzähler = 4-bit decimal/binary counter

The AFDEM module first limits the IF signal through a comparator circuit. Then the data goes through a low-pass filter and through a full-wave rectifier. This doubles the frequency. This new frequency of 2700 Hz is passed through a band pass filter and is then squared. This square wave is regenerated in a second-order phase-lock loop and is then divided by two in frequency by means of flip-flop. This then becomes the estimate of the carrier frequency and is used to demodulate the signal in an exclusive-or gate. After passing through a further low-pass filter, the D⊕Cl signal is obtained.

The BITREG module again limits this signal in a comparator. The zero crossings generate a pulse which exits through an 800 Hz bandpass filter. After processing the 800 Hz 2x clock signal, a phase-lock loop regenerates the signal, and further division provides a ± Cl signal. (The ± is used here to indicate a phase ambiguity of ±180 degrees.)

The zero crossings of the limited input signal are used as the clock in a four-bit up-down counter. Up-down control is effected by a signal shifted 90 degrees with reference to ±Cl. Thus, a down count occurs for each zero-crossings in the center of the bit; an up count occurs at bit boundaries. The counter is locked to prevent counts below zero or above 15. Since there are more zero crossings in the bit center as compared to the bit boundaries, the counter will remain near zero. If the phase angle of ±Cl is erroneous, then the counter will have a value near 15. The output of Q4 is then used to invert the phase of ±Cl.

The recovered bit-rate just described is used to demodulate the input signal in an exclusive-or gate and feed it to an integrator. The integrator takes the average of the data bit. At the end of the bit duration, a check is made with a comparator to see if the integration process produced a positive or negative value, and thus whether a zero or a one was present. After this, the integrator is reset to be ready for the next bit. The SYNINF stores each data bit. The difference between the present and the previous bit is shifted into an 8-bit shift register.

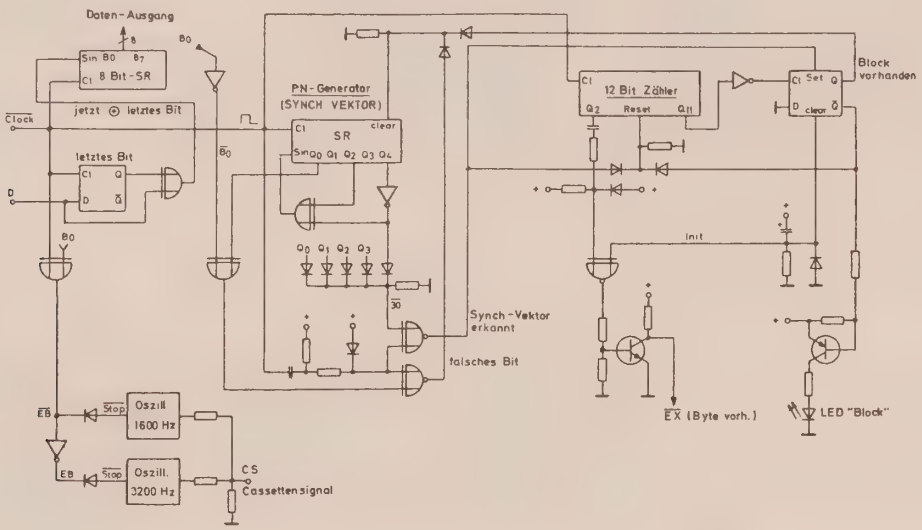


FIG. 7: SYNINF

Cassetten signal = cassette tape recorder signal

falsches Bit = erroneous bit

Synch-Vektor erkannt = Valid sync. recognized

Daten-Ausgang = data output

jetzt = now

letztes Bit = last bit

12 bit Zähler = 12 bit counter

Block vorhanden = block available

$\overline{EX}$ (Byte vorh.) = Byte ready for pickup by computer

The first bit in the shift register is compared in the middle of the bit duration (half a period later) to a bit generated by a shift register PN generator. If the data bit does not compare with the synchronous bit, it causes the PN generator to be reset. Only if all bits check properly, the last position of the PN generator is readied and a pulse is formed which starts a 512 byte counter. As each byte is sent to the computer, this counter advances and generates a signal to indicate to the computer that a byte is available in the 8-bit shift register and that it may pick it up there for further processing (interrupt).

While a data block is being transferred, no sync checking is taking place. The transfer is ended after 512 bytes, and the circuitry waits again for the next sync vector.

The whole technique is being developed through the linear transponder DLØTU. The beacon operates on 145.865 MHz and uses the 400 bit per second AMSAT technique and is available for experiments. Error-free reception of the telemetry is possible with a signal of only 4 dB S/N at a 2.5 kHz bandwidth.

Editor's Note - Printed circuit boards for these circuits will be made available to members to aid in the construction of receiving equipment for the PSK telemetry. An announcement will be published in the Newsletter when they become available. Please wait for it!

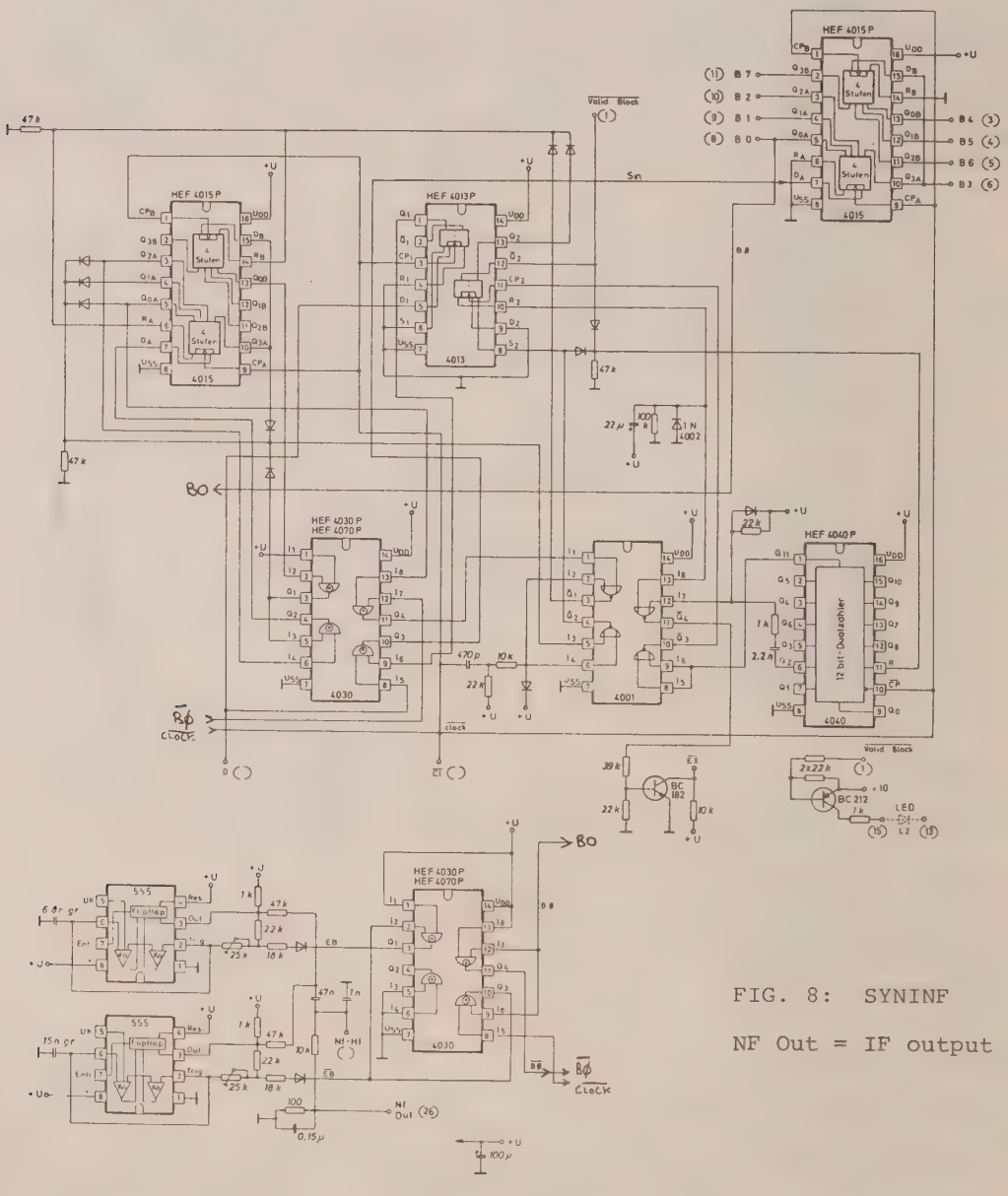


FIG. 8: SYNINF

NF Out = IF output

PROBLEMS WITH RS

By Gregory Roberts, ZS1BI
AMSAT S.African Representative

As amateur satellite communicators are well aware, the USSR placed Radio One and Radio Two in orbit with the launch of Cosmos 1045 on October 26, 1978. SPACE-WARN gave the following identifications for the various components:

78 100A	Cosmos 1045	78 100C	Radio Two
78 100B	Radio One	78 100D	rocket body

Since I am in a fortunate position in that I receive NASA two line orbital elements for all unclassified objects in earth orbit, and also have access to a NOVA computer, I was able to generate predictions for the two RS satellites and distribute such to active satellite users in Southern Africa, thus permitting a fair amount of activity on the two satellites as they passed over Southern Africa.

However, by mid November it became apparent that a problem existed somewhere as the predicted time error was increasing. 78 100B matched up well with one of the satellites heard, but those for 78 100C were rapidly departing from the computed time. It was also noted that the predictions given by the AMSAT International Net did not agree with those for 78 100B. Not wishing to doubt NASA I then made the assumption that Radio one had been misidentified with Radio Two, and accordingly informed Will, WA3NAN on the 3rd December 1978 AMSAT Net.

By mid November I had decided that 78 100B was in fact Radio Two, but was still calling 78 100C Radio One and the predictions issued were based on this assumption.

In early January the problem really began to worry me as the satellites were in a stable orbit and, if the identifications of NASA were correct, then the errors should be less than a minute at most. This was not the case, so I decided to check all the objects launched with this launch. The satellites were making passes under conditions suitable for optical tracking, and Radio One and Radio Two were sufficiently far apart to avoid confusion. Predictions for all four objects were run on the computer, and the ten metre band monitored was in fact Radio One and not a Cosmos satellite. I was happy with the identification of 78100B as Radio Two, so that left Cosmos 1045 to be identified. The new results were:

SATELLITE IDENTIFICATION	NASA	ZS1BI
78 100A	Cosmos 1045	Radio One
78 100B	Radio One	Radio Two
78 100C	Radio Two	Cosmos 1045
78 100D	rocket body	rocket body

This I communicated to Will, WA3NAN on the AMSAT net on 28th January 1979, who in turn passed it onto the Satellite Operations at Goddard, so hopefully the two line orbital elements will shortly reflect the true situation.

I also resurrected one of my smaller satellite tracking telescopes from my MOONWATCH days and observed the satellites visually as follows:

78 100A	magnitude 8, steady at a range of 1800 kilometres
78 100B	magnitude 7½, steady at a range of 1800 kilometres
78 100C	magnitude 7, essentially steady with very small variations in brightness, range 1700 kilometres
78 100D	magnitude 6½, steady at a range of 2200 kilometres

This means that all these satellites should be visible in a pair of 7 by 50 mm binoculars.

I am quite surprised that so much time and effort was placed on orbit determination using doppler for the RS satellites, as one good optical observation at culmination is vastly superior to a time of closest approach doppler -- especially on ten metres. For the doppler fans I would like to state that I have had considerable experience of using both techniques for orbit determination with 100% success in both cases, so it's not as if I were a stranger to either technique.

By using optical observations of a satellite pass made at culmination over a period of say a week, it is possible to very accurately determine a satellite orbit -- i.e., the six parameters needed to define a satellite orbit uniquely.

(Continued on Page 31)

PROPOSED AMSAT PHASE III SATELLITE BANDPLAN

By Vern "Rip" Riportella, WA2LQQ
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Warwick, NY 10990

Note: The following article is being published for AMSAT member comments.

INTRODUCTION

The forthcoming launch of AMSAT Phase IIIA (Ø3A) is the first of the Phase 3 satellites. In its high elliptical orbit it will offer Amateurs a unique communications vehicle. Its capabilities will be unprecedented in Amateur practice. With the DX communications potential of 15 to 20 meters at their best, and the predictability of line-of-sight VHF communications, Ø3A will represent a quantum leap in Amateur communications capabilities. With this potential firmly in mind, the AMSAT Phase III Operations Advisory Group has proposed a bandplan for Ø3A. This article will discuss the plan, the implicit practical considerations and the resultant bandplan itself.

NEED FOR A PLAN

Fundamental to planning the utilization of the Ø3A spectrum is a view to experience acquired through ten years of accumulated transponder operations with satellites. The Phase II satellites, i.e., OSCARs 6, 7 and 8, provided Amateurs worldwide with a new communications vehicle or medium. Amateurs were afforded reliable VHF communications on an international scale. However, due to their low orbital altitudes, Phase II satellites were visible to a given point on the earth's surface for 20 to 30 minutes per orbit, at best. Thus, communications tended toward the short, contest-type exchanges of signal report, name and QTH. Because of the high elliptical orbit planned for Ø3A, visibility will more often be measured in terms of several hours and the short exchanges so typical of Phase II will likely evolve to more protracted, easy rag-chews, round-tables and net-type operations. On Ø3A, DX-chasers will find new challenges to supplant past laurels. With this diversity immediately apparent and the consequent risk of congestion reminiscent of a contest weekend on 20 meters a hazard, the Advisory Group set about to address the design philosophy of the Ø3A bandplan.

BANDPLAN PHILOSOPHY

The bandplan design philosophy must recognize the essential difference in the nature of the communications which will likely occur on Ø3A compared to Phase II. Specifically, the bandplan must, if it is to be effective, recognize that functionally the communications on Ø3A will likely be a VHF analog of the present traffic on the Amateur HF bands. The bandplan must thus provide for both the popular modes of SSB and CW and the specialized modes of RTTY and SSTV. The bandplan must also provide for a broad range of "traffic" types including formal traffic nets, rag-chews, DXing, round-tables, educational endeavors such as demonstrations to students, and scientific research. Of potentially significant public service import is the capability of Ø3A to provide vital emergency communications to disaster-affected remote areas. In times of great natural disaster the proper, informed use of Ø3A may well pave the way for future Amateur Radio "social-value-judgments." A good showing here in the crucible of public opinion is absolutely essential. The potential for positive action in the form of international emergency communications on Ø3A is great enough that if the bandplan did not address this potential directly, it would likely contribute to the loss of a powerful rationale for justifying Amateur Radio's existence in the coming decades.

Finally the bandplan must be flexible so as to accommodate anticipated technical advances, e.g., narrowband voice modulation (NBVM), new applications areas, e.g., data networks, as well as unanticipated technical and social developments which could occur within Ø3A's operational lifetime. This is not to say, however, that all contingencies must be anticipated and provided for. Nor does it mean that the bandplan, once formulated, is necessarily "cast in concrete" never to be modified. It does mean, on the other hand, that the bandplan adopted should be realistic in terms of recognized requirements and responsive to tomorrow's evolutionary requirements. Therefore, in general, the Ø3A bandplan must reflect the extant, identifiable requirements of present satellite communicators, the projected requirements of the anticipated influx of new users, and the growing technical sophistication and diversity of the advanced experimenter with the array of equipment and procedures at his or her disposal. Furthermore, the bandplan must be responsive to these requirements in an international context with a potential

complexity greater than any satellite operations Amateurs have experienced to date. However, just as the potential for vast improvement is afforded, the Ø3A spectrum utilization must, by its very nature and scope, be carefully planned, orchestrated, and implemented if spectral chaos is to be avoided.

THE PROPOSED BANDPLAN

The Ø3A transponder is functionally similar to the AO-7 Mode B transponder in that the uplink is at 70 cm and the downlink is at 2 meters. Figure 1 shows the relationship between uplink and downlink signals for Ø3A as of this writing. As with AO-7B, Ø3A has an inverting transponder, meaning that signals sent on the low end of the 70 cm uplink will appear on the high end of the 2 meter downlink, and USB transmissions will be heard on the downlink as LSB.

The proposed bandplan is based on the 2 meter downlink passband. That means that the satellite downlink is the frame of reference for passband partitioning. The user is thus obliged to control the 70 cm uplink frequency to assure that the resultant 2 meter downlink frequency falls within the recommended allocation for that mode/service (to a reasonable tolerance). More on this topic below.

The 180 kHz wide downlink passband is partitioned into three major usage bands. These in turn are further divided into sub-bands by emission type. The three major usage bands are:

1. General communications band
2. Channelized special services band
3. Beacon and guard channel band

These three bands will now be examined in detail (Refer to Figure 1 and the notes thereto).

GENERAL COMMUNICATIONS BAND

The general communications band is tentatively 124 kHz wide with edges at: 145.838 and 145.962 MHz. This band is further divided into three sub-bands by emission type as follows:

CW (Lowest third): 145.838 - 145.880 MHz
Mixed CW/SSB (Center): 145.880 - 145.920 MHz
SSB (Upper third): 145.920 - 145.962 MHz

} All freq. specs subject to tolerance of ±5 kHz pending spacecraft calibration.

This partitioning roughly parallels HF practice and is essentially identical to the current Phase II satellite bandplan first proposed by G3IOR and G3ZCZ. The "special" emissions currently used (e.g., RTTY, SSTV) are allocated to the "seams" as shown in Figure 1. It is anticipated that future modes such as NBVM will take up residence at indeterminate but consistent frequencies within the appropriate sub-band much as SSTV activity presently clusters at about 14.230 MHz on 20 meters.

CHANNELIZED SPECIAL SERVICES BAND

The second major band within the 2 meter downlink is allocated to channelized special services. This is a new direction for Amateur satellites and is in marked contrast to the non-channelized communications predominating the Amateur bands with notable exception of the VHF/UHF repeater bands. Six Special Service Channels (SSC) are presently proposed, though more can be added as/if requirements warrant. As shown in Figure 1(and notes thereto), these SSC designations are as follows: (L = Low end of 2m passband; H = High end)

L1.....Scientific channel

L2.....Data exchange network channel

L3.....NTS (National Traffic System) Formal CW record traffic net and/or its international equivalent

H1.....Code Practice; CW/RTTY Bulletins

H2.....Educational channel

H3.....General bulletin channel (voice)

As explained in the notes to Figure 1, all SSCs are 4 kHz wide and their placement is at the passband extremities just above and below the beacons and their associated guard-bands. The various SSC functions are explained below.

(Continued on Page 18)

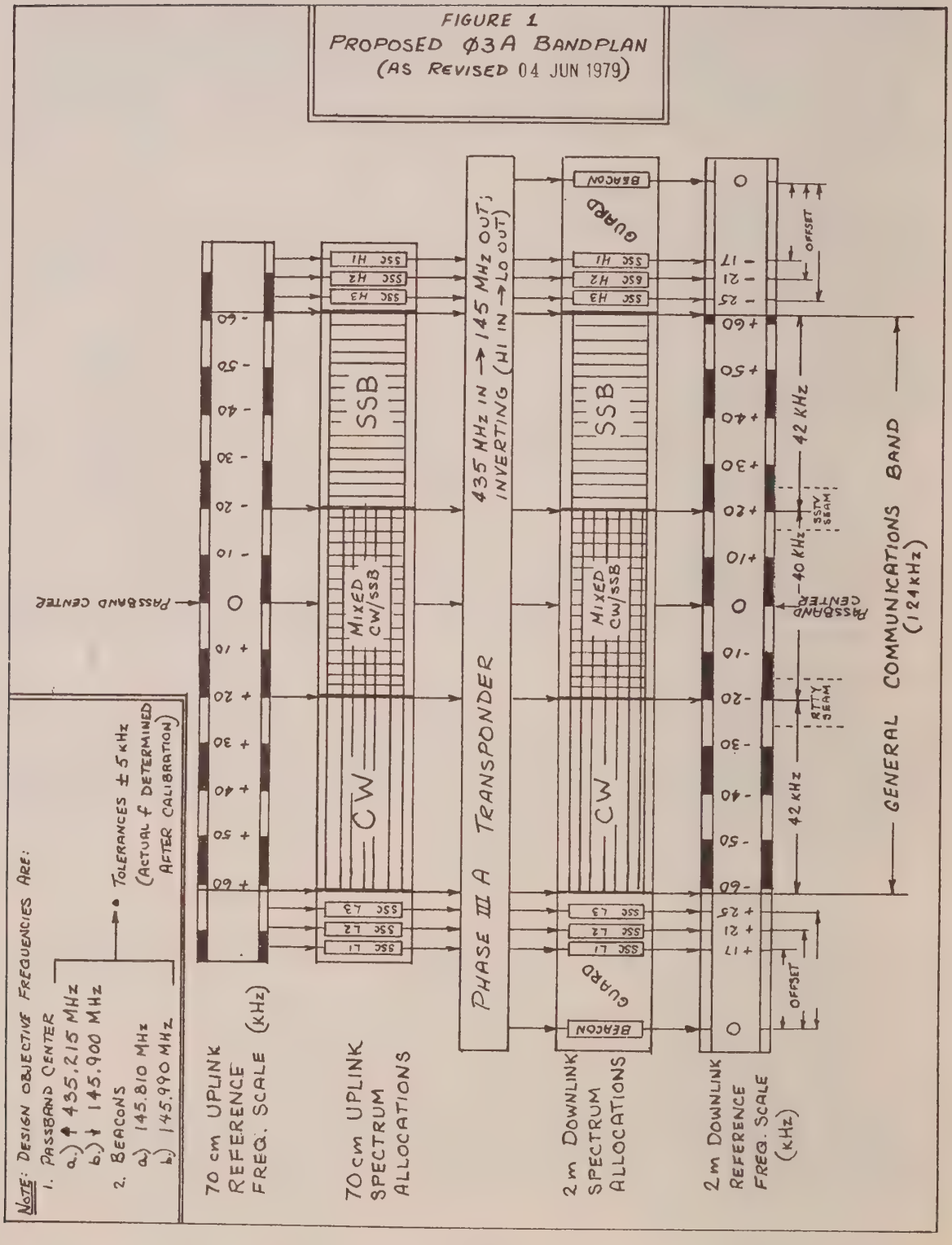


FIGURE 1
PROPOSED Ø3A BANDPLAN
(AS REVISED 04 JUN 1979)
NOTE: DESIGN OBJECTIVE FREQUENCIES ARE:
1. PASSBAND CENTER
a.) ↑ 435.215 MHz
b.) ↓ 145.900 MHz
2. BEACONS
a.) 145.810 MHz
b.) 145.990 MHz
• TOLERANCES ±5 kHz (ACTUAL f DETERMINED AFTER CALIBRATION)
70 cm UPLINK REFERENCE FREQ. SCALE (kHz)
70 cm UPLINK SPECTRUM ALLOCATIONS
PASSBAND CENTER
SSC H1
SSC H2
SSC H3
SSB
MIXED CW/SSB
CW
SSC L3
SSC L2
SSC L1
PHASE III A TRANSPONDER
435 MHz IN → 145 MHz OUT; INVERTING (HI IN → LO OUT)
BEACON
GUARD
2m DOWNLINK SPECTRUM ALLOCATIONS
2m DOWNLINK REFERENCE FREQ. SCALE (kHz)
OFFSET
42 kHz
40 kHz
SSTV SEAM
RTTY SEAM
PASSBAND CENTER
GENERAL COMMUNICATIONS BAND (124 kHz)

NOTES TO FIGURE 1

1. SSC-L = Special Service Channel, Low end
2. SSC-H = Special Service Channel, High end
3. Channel designators (e.g., L1, L2, H3, etc.) refer to SSC position in passband. L1 is: LOW end, first channel from reference pilot (beacon). H2 is: HIGH end, second channel from reference pilot (beacon). Future expansion of number of SSCs would be from L3 and H3 inwards to the center of the passband. New designations are made in pairs and split between SSC-L and SSC-H so that the allocation is symmetric about the passband center. Spacing shall be at 4 kHz centers unless study of Doppler compensation problems reveals this to be ill-advised whereupon the spacing will be increased as is appropriate. At this juncture and for planning purposes, 4 kHz centers seem a reasonable tradeoff between the risks of adjacent channel interference on one hand, and spectrum utilization on the other.
4. Tentative SSC allocations are as follows:

   L1: Scientific (N1DM coord.)
   L2: Data (WA2LQQ acting coord.)
   L3: NTS (K1XA coord.)
   H1: CW Practice (W1NU acting coord.)
   H2: Education (WB1EYI coord.)
   H3: General bulletin (W1NU coord.)

5. A communications emergency will take precedence over all Ø3A routine communications. In the event SSC resources are required, SSC control will be yielded to emergency use. Specific emergency notification procedures will be formulated and disseminated at a later date.

6. SSC users are responsible to:

   a) Schedule with appropriate SSC regional coordinator
   b) Control 70 cm uplink frequency such that the 2 meter downlink frequency (as monitored at the signal originator's QTH) is at the specified offset from the pilot (beacon) to within a tolerance of ± 1.0 kHz. Use of the SSCs with equipment incapable of this tolerance is discouraged.

7. Emission Types and Bandwidth:

   a) A3J should be 2.4 kHz at the 3 dB points. USB for the 70 cm uplink (as in AO-7B) and which results in LSB downlink on 2 meters
   b) A1 per HF practice
   c) F1 (RTTY) is not encouraged for power efficiency reasons. A1 RTTY should be considered (On-Off keying for the mark-space functions)
   d) A3J SSTV per HF band practice
   e) In general, all angle modulation schemes (i.e., FM, PM) are not power-efficient and are thus to be discouraged.
   f) Pulse modulation is not authorized for Amateur use below 2.3 GHz and is not power-efficient. However some experiments with P3 and P3G (PCM) in particular may find limited experimental use in SSCs L2 and H1 under an F.C.C. S.T.A. and if approved by the Ø3A licensing authority (Germany). In any case, however, bandwidth limitations will limit P3G schemes to 2.4 kHz. ASCII-coded A1 emissions (if authorized) will probably be limited to 1200 baud for the same reasons. 600 baud is likely a more prudent choice for ASCII-coded A1. All transmissions on SSC L2 likely will be half-duplex (HDX) or simplex (SPX) though full-duplex (FDX) operation by use of adjacent channels is left for further study. A3B (ISB) emissions or use of USB/LSB combinations for FDX operations may be of interest here.

8. SSC offset is to channel center from pilot in kHz. When using A3J (SSB), center of channel is where carrier whould be if A3 (AM) were used. A1 (CW) users set exactly on SSC center (± 1.0 kHz). If operations prove it feasible, more than one CW station may be allowed to occupy a SSC (e.g., SSC L3a and L3b, etc.)

L1 (Scientific): This SSC is proposed for serious research into phenomena/ techniques where Ø3A is a vital experimental component.

L2 (data): The data channel is dedicated to providing a means for licensed Amateurs who are also computer hobbyists to network their computers through the satellite. The potential use of this channel should stretch the imagination of even the most visionary of Amateurs who, as it were, have one foot in the Ham bucket and the other in the computer box. Though some preliminary work in this area has been done and articles have appeared in the media,* much work has yet to be done, especially in the area of standardizing interfaces and protocols. Nevertheless, in proposing this SSC use, AMSAT recognizes that such a network is imminent. (*See Byte Magazine, November 1978. Editor)

L3 (NTS): The NTS channel is dedicated to scheduled, formal, record, CW traffic-handling similar in function to present nets.

H1 (CW Practice): CW code practice and CW/RTTY Bulletins

H2 (Education): This SSC is proposed for scheduled school demonstrations and other coordinated educational objectives.

H3 (Bulletin): Of the SSCs, the proposed general bulletin channel will probably be of the greatest interest to the majority of Amateurs. Plans call for this SSC to be employed for transmission of general interest bulletins and satellite orientation information in the world's major languages. The orientation function would serve as a "roadmap" to satellite usage and locations of activities much as one would find upon entering a museum or convention. This channel would be used for both "real-time" and pre-recorded messages beamed from earth to be transmitted on a continuous basis. ARRL, RSGB, DARC, REF, AMSAT, IARU, AMSAT Member Societies and other official bodies/agencies will be called upon to supply the bulk of the text for the bulletins.

CHANNEL COORDINATION

The advent of channelized communications on a satellite poses new challenges for administration of the passband spectrum. Close coordination among a well-knit group of channel coordinators is mandatory. This coordination must in turn be based on a concise, comprehensive plan which is both widely disseminated and easily implemented. The following paragraphs address this coordination challenge in general.

In order to provide maximum channel utilization and to eliminate contention for channel time, a well-organized system of coordinators and procedures is essential. Furthermore, since the geographical position of the satellite (and thus its accessibility) will vary in time of day from orbit to orbit, consistent time-slot allocations cannot be made based on time of day. For example, regional bulletin stations cannot be assigned a time-slot of, say, 0130 to 0200 UTC, daily. Instead, assignments of time-slots are made on the basis of the time when the SSP is within that station's region. (The SSP or Sub-Satellite Point is that point on the earth directly "beneath" the satellite, or, to be somewhat more precise, that point on the earth's surface which lies on a line connecting the earth's center with the satellite).

The individual regional bulletin stations are responsible for assuming the bulletin function when the SSP is within their assigned region based on the geographical coordinates defined for that region. This responsibility passes from bulletin station to bulletin station as the SSP enters and exits their assigned region. Minimal "guard zones" will be determined to avoid channel contention between bulletin stations. Thus, the time at which "turnover" occurs must be computed based on a knowledge of SSP motion. The SSC coordination and turnover for the other SSCs will be handled analogously.

CHANNEL COORDINATION ORGANIZATION

The planned overall organization responsibility is discharged through the organization depicted in Figure 2.

To request and reserve an educational channel allocation on SSC H2, for example, the user would contact the Educational Coordinator in the region where the user is located. This coordinator will then advise the user of available time-slots and note the user's preference and reservation for a particular slot. It should be emphasized that should any SSC become inordinately backlogged with allocation requests, SSC L3, the designated spare may be used if not otherwise committed. Additionally, the general communications band is always open to appropriate traffic should demonstrations be needed on short notice. Should a

trend be manifest that indicates consistently high SSC usage tending to overload, new SSC designations could be made. (See also the notes to Figure 1).

DOPPLER COMPENSATION

At this point, it would be well to mention an important aspect of Ø3A usage, expecially as regards SSC communications. Because of the motion of the satellite and the consequent Doppler shift, the frequency at which a signal is received will depend on the locations of the transmitting QTH, the satellite and the receiving QTH, and the relative motion of the satellite to these QTHs. (radial velocity)

Two points need be examined here. These address the differences in the orbital velocities of Phase II and Phase III satellites. First, on Phase II satellites, the challenge of Doppler shift frequency tracking was not so much the magnitude of the shift itself, but rather the manner in which the magnitude changed as a consequence of the angle of approach of the satellite to the QTH of the observer. However, since Phase II satellites were placed in near-circular orbits, their orbital speed was very nearly constant. Second, since Ø3A will be placed in an elliptical orbit, its orbital speed will not be constant. Thus a new factor, radial acceleration, is introduced. In the planned Ø3A orbit, the orbital speed will vary over a range of about 5 to 1. So with Ø3A, the rate of change of Doppler shift will be a function of not only angle of approach but radial acceleration.

Marty Davidoff, K2UBC, has modeled the Ø3A Doppler problem for a worst-case, static earth model. His calculations assume the earth is non-rotating and he shows that the error attributable to this assumption is negligible for a first approximation calculation. The worst-case assumption means that the Doppler shift predicted is for a point on the surface of the earth that at that instant will observe the highest Doppler shift. As would be expected, this worst-case point moves along the earth's surface as the satellite moves and, from the satellite's perspective is at the very edge of the visible area of the surface. Thus, this model is not valid for a given, fixed QTH. Rather, it shows the upper bound for shift, and all stations will observe lesser shifts (except the location on the worst-case point for that instant.) The Doppler shift model will be explored more fully in a subsequent article by K2UBC/WA2LQQ.

Figure 3 is a graph resulting from the model discussed above. It represents the net shift in frequency through the transponder and accounts for uplink shifts, downlink shifts and the inverting function of the transponder. Interpreting the graph, one observes that the rate of change of frequency is quite low. In fact, the average change in frequency for the period of apogee plus or minus four hours is about 13 Hz/minute. Thus for an 8 hour window, the net rate of change in received frequency will be less than the drift in some equipment! Though the magnitude of the Doppler shift is about 8 kHz at perigee, again the rate of change in periods other than that close to perigee is small indeed. Even at perigee, the frequency tracking problem should be no worse than Phase II satellites (modes B/J). So, overall, the Doppler shift problem seems manageable. How does the bandplan reflect the Doppler considerations?

In the general communications band, the frame of reference for downlink frequency is the downlink frequency as heard at the station originating the uplink signal. Though this signal will be heard at slightly different frequencies at different locations, the general communications band is tolerant of these differences. The philosophy here is that the difference between the frequency of the downlink signal at the originator's station and all other points is negligibly small.

The SSCs, however, require some extra care in determining downlink frequency. In order to avoid adjacent channel interference, it is necessary that the SSC downlink frequency be referenced to the beacon channels in terms of offset. The beacons thus serve as pilots for the offset. The SSC user must adjust the uplink transmit frequency to provide the specified offset (as shown in Figure 1) to a reasonable tolerance. In this way, the uncertainty in the magnitude of the Doppler shift is largely eliminated since the frame of reference is not the absolute received downlink frequency of the originating station's signal at the originating station, but rather the relative downlink frequency offset referenced to the pilot (beacon). This offset is very nearly equal for all locations regardless of Doppler shift. Therefore, the place of appearance of the SSCs on one's receiver "dial" may vary with time, but the spacing between SSC will not vary and the elimination of adjacent channel interference should be accomplished.

Tolerances for offset must be specified and suitable techniques for incremental or continuous correction to uplink frequency must be identified and developed. Though the overall problem of adjusting offset of the SSCs from the pilot is well within the grasp of present experienced satellite users, it is not an area recommended for newcomers to "get their feet wet."

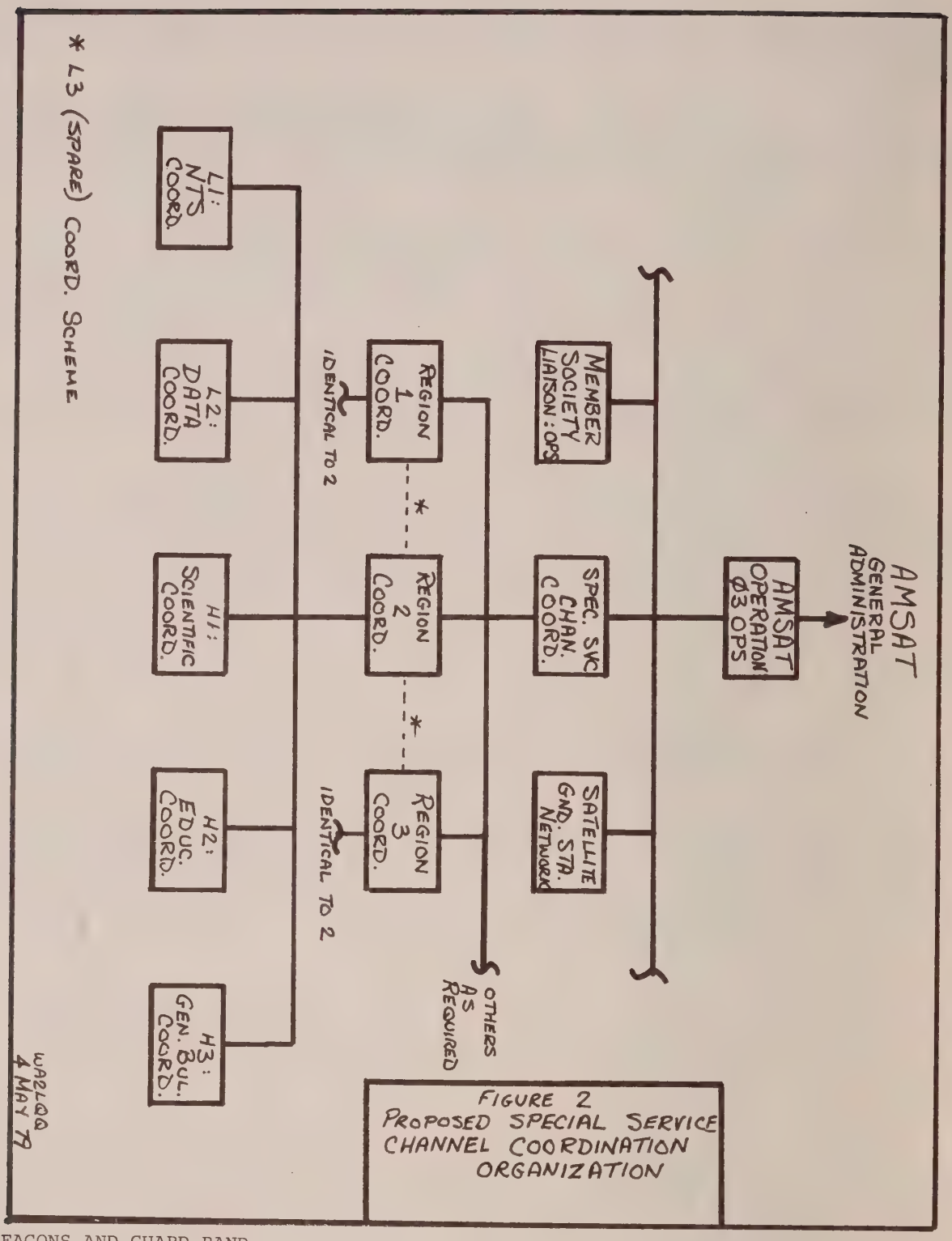


FIGURE 2
PROPOSED SPECIAL SERVICE CHANNEL COORDINATION ORGANIZATION

BEACONS AND GUARD BAND

The third and final portion of the 2 meter downlink passband is assigned to the two beacons with 17 kHz guard bands as shown in Figure 1. There has been some suggestion to use part of the guard bands nearest the SSCs for specially equipped, high-power stations for bulletin transmission instead of allocating a specific SSC to this function. This suggestion will bear some study and some experience in actual Ø3A operations since assigning bulletin stations to the guard band area where transponder receiver sensitivity rolls off quite rapidly (10 dB/10 kHz) may place an undue burden on modest-powered stations and their ability to present a readable signal through the transponder. The function of the beacons and their operations have been and will be covered in other articles, so they will not be further addressed here.

CONCLUSION

The Ø3A satellite marks the opening of a new age in Amateur Radio communications. In a sense, the previous eight AMSAT OSCARS have been a warm-up for the coming "big-show." The prospects for accomplishment are truly enthralling. And the promise of productive public service, scientific advancement, technical innovation, international cooperation and just plain fun in "hamming" makes these exciting times indeed in Amateur Radio. AMSAT expects that the proposed Ø3A bandplan discussed in this article will lay the operational foundation necessary and sufficient for its efficient use throughout Ø3A's operational lifetime.

Suggestions for changes to the proposed bandplan are requested and volunteers for the challenging (and taxing) role of Regional SSC Coordinator are actively solicited. Please address your letters to K1HTV, C/O AMSAT.

My personal thanks to those who contributed to the bandplan discussed herein and whose ideas are reflected throughout: K1HTV, W9KDR, K2ZRO, WB2LEI, N1DM K1XA, W1NU, WB1EYI, K1JX, K2UBC, K1ZZ, K1RT).

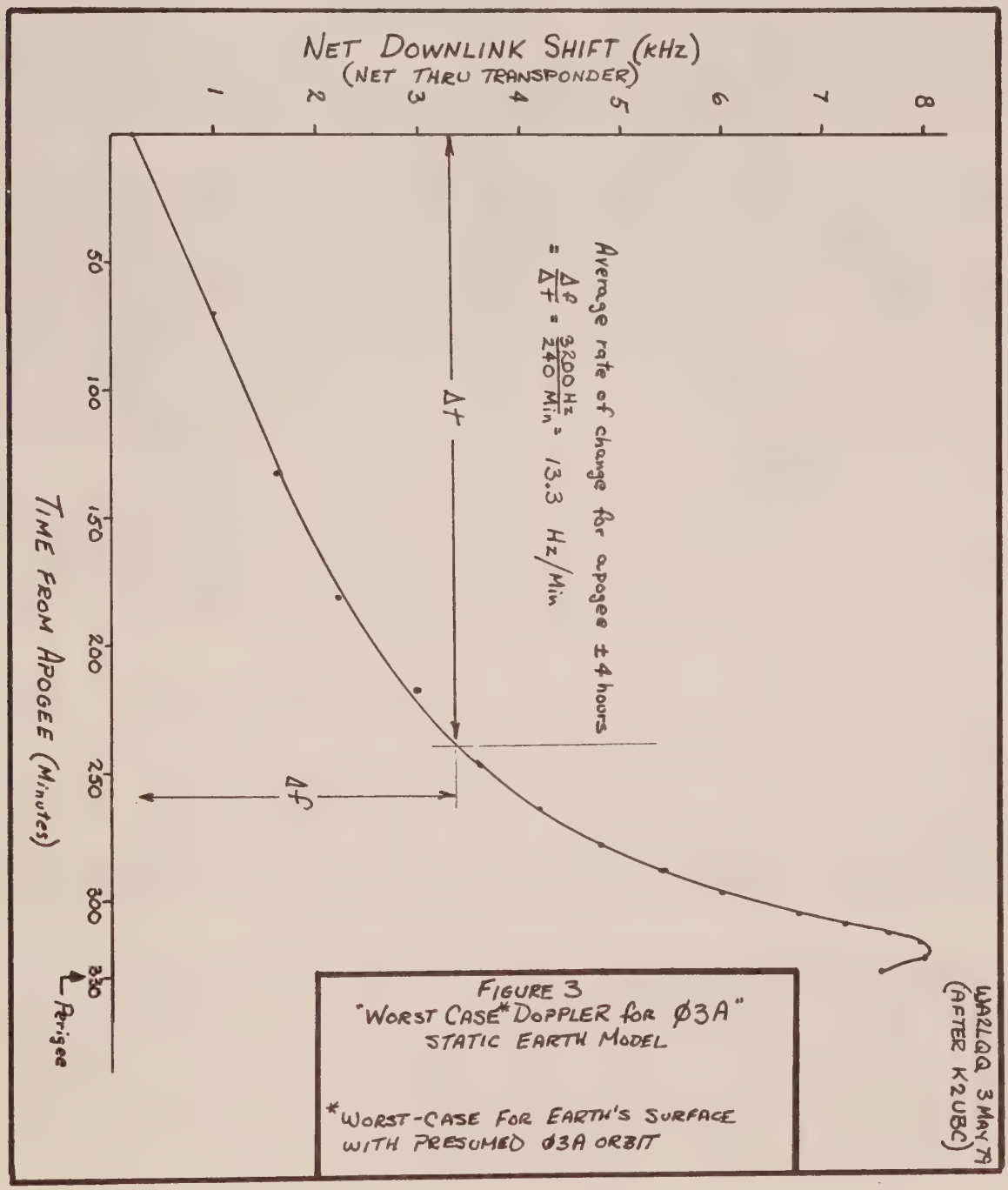


FIGURE 3
"WORST CASE* DOPPLER FOR Ø3A"
STATIC EARTH MODEL

*WORST-CASE FOR EARTH'S SURFACE WITH PRESUMED Ø3A ORBIT

PROPOSED AMSAT PHASE III SATELLITE GENERAL BULLETIN CHANNEL

By Vic Politi, W1NU
Kaz Deskur, K2ZRO

The first of a series of meetings on Phase III operations by an AMSAT Operations Advisory Committee was held at ARRL Headquarters, Newington, Connecticut, on April 7, 1979. At this meeting a Phase III bandplan was drafted. This proposed bandplan is unique in that dedicated channels for Scientific, Data, Educational, General Bulletin and National Traffic System use are to be assigned specific frequency assignments within the downlink passband. (For a detailed sketch of the bandplan refer to the article on that subject by WA2LQQ which appears in this issue of the Newsletter.)

This article is concerned with the Phase III General Bulletin Channel and its proposed use on a world-wide basis.

The initial AMSAT Phase III satellite will have an approximate 11 hour elliptical orbit. This means that during any given orbit, visible in the northern hemisphere, numerous countries will have access to the General Bulletin Channel. With the many different languages spoken in this hemisphere, utter chaos would result if some sort of time sharing of this channel were not implemented on a coordinated basis.

The Phase III General Bulletin Channel calls for fulltime usage to assigned bulletin stations throughout the world on a scheduled, coordinated, regional basis. This channel will be a very useful tool to the satellite user or listener. For instance, a typical bulletin transmission might carry orbital data on the various active amateur satellites, late breaking happenings from AMSAT, IARU and ARRL Headquarters, and bulletins of general interest from the world's various radio societies, such as new technical developments, revised regulations, election of society officers and upcoming dxpeditions, etc. Pre-recorded cassettes in different languages could be used for those particular countries where one-way bulletin transmissions into the transponder are prohibited. The cassettes could be simply forwarded to a country where it is legal to do this and that country's bulletin station could then play the cassette through the transponder on the regional time slot allocated to the originating country. (For example, AMSAT UK, where one-way transmissions are forbidden, could ship the cassettes to another nearby European country where they are allowed).

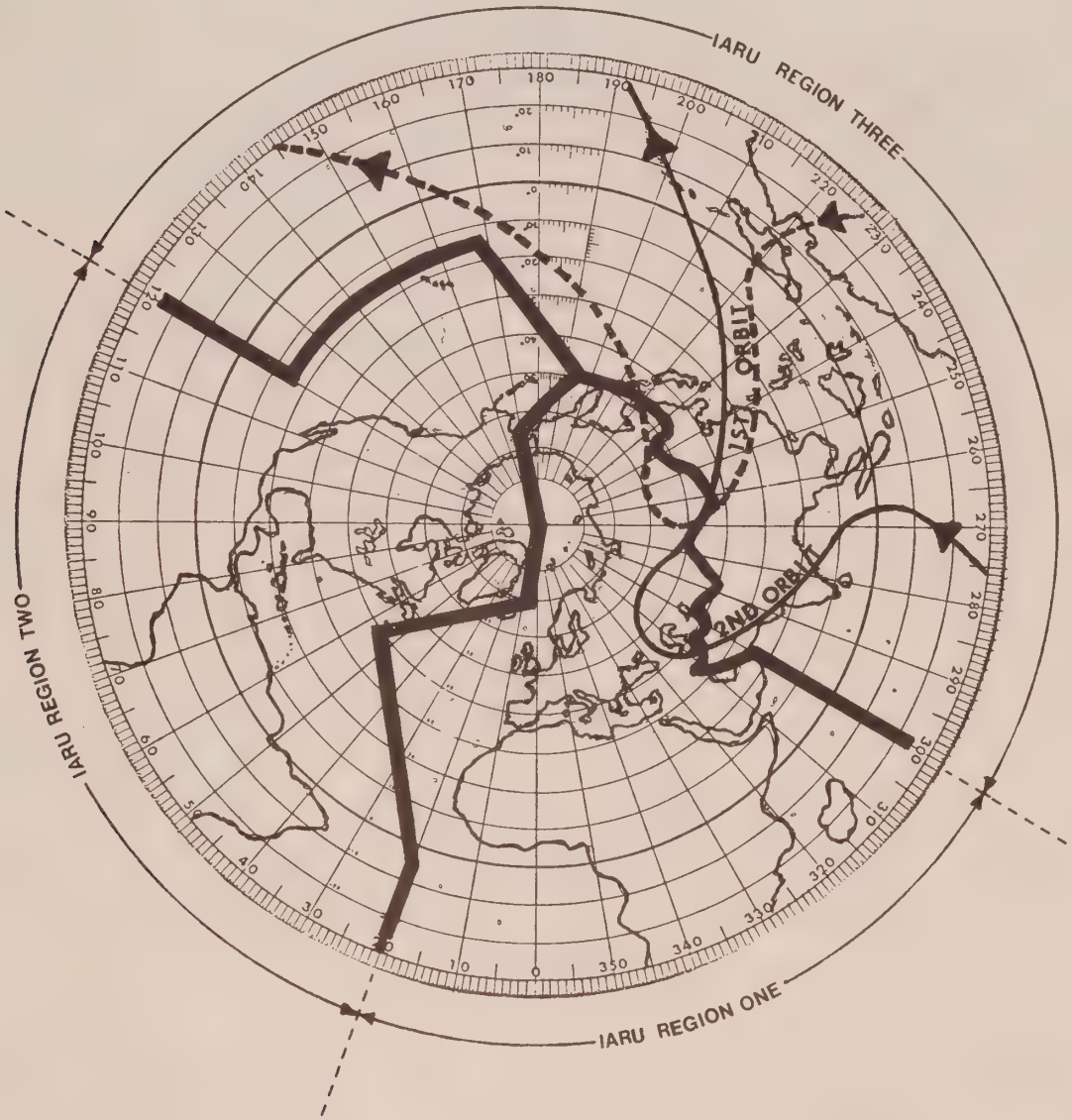
Coordination and scheduling time slots to the various bulletin stations will be a major problem. Unlike the Phase II orbits, Phase III will do a "hairpin" around the hemisphere, negating daily bulletin schedules at a fixed orbit such as is done on our present Phase II sun-synchronous satellites. This problem can be solved by dividing the hemisphere (or world if you will) into segments or regions and assigning Regional Bulletin Coordinator stations to schedule and coordinate bulletins in their individual sectors.

The initial proposal by the committee called for using an existing ready-made geographical split of the world as a starting point. This existing split, known as the International Telecommunication Union (ITU) Regional Plan, also adopted by the International Amateur Radio Union, divides the world into three distinct regions. Figure 1, shows the ITU/IARU plan on a Polar Projection map such as we use for satellite tracking. (By the way, if you are not familiar with the IARU, an excellent article on this organization appeared in the January 1979 issue of "Ham Radio Horizons" magazine.) The regions seem usable as they are at first glance, but after applying some Phase III orbital overlays (Fig. 1) it can be seen that some major adjustments would be required to satisfy the proposed plan. It was therefore decided to forgo the ITU/IARU plan and approach the problem from a different angle.

The new proposal was generated by looking at the Phase III orbits and finding out what would be the prime time for a bulletin transmission to take place. As stated above, this is the time approaching and leaving the orbital apogee. It is actually one hour before and three hours after apogee. During this time slot, the satellite remains almost stationary with respect to the earth, covers the widest communications range, and experiences only negligible Doppler shift. All the above-mentioned properties simplify automatic transmission toward the satellite because steerable antennas (following the satellite's progress) will not be necessary. Small Doppler shift will maintain the signal within close tolerance at the receiving end, and, of course, the largest range will be covered. A bulletin station will be able to pre-set the direction of the antenna and use a programmed timer to commence the transmission with minimum of human intervention.

FIG. 1

The heavy lines show the ITU/International Amateur Radio Union regional boundaries as they appear on a Polar Projection map. If this plan were to be used, it would necessitate some boundary changes. Two Phase III orbits are shown to reflect this. Please note that the two tracks shown are not consecutive orbits. They represent any two orbits in this part of the hemisphere.

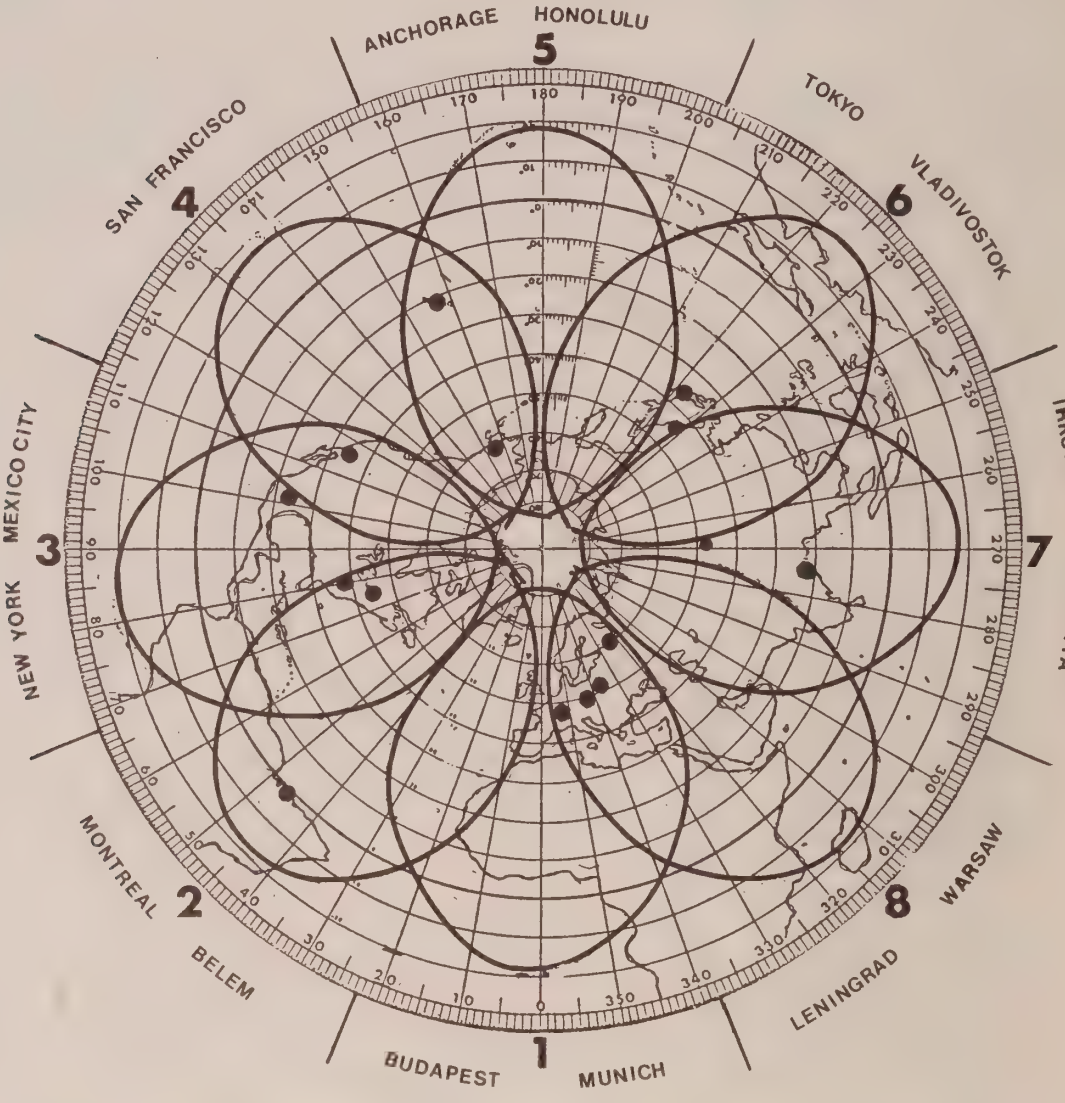


Allowing 15 minutes per language, the same bulletin in eight different languages can be transmitted within the two hour period. It has been our experience with AMSAT-OSCAR's 6, 7 and 8 that bulletins lasting only ten minutes were adequate to convey all important information.

For the first few years, the apogee of Phase III satellites will occur at northern latitudes ranging between 26 and 57 degrees. The full communications range at, or near, the apogee will cover a circle with a radius of nearly 9000 kilometers. In order to assure very reliable reception, however, the satellite should be visible at an angle of 20 to 30 degrees above the horizon of the receiving station. This requirement would reduce the service area to a 6000 km radius. It is proposed that the bulletin stations transmit their messages within the period when the satellite's apogee is in the most favorable position (high over the horizon) and that the service area of each particular station cover the intended part of the globe. Figure 2 illustrates this principle.

FIG. 2

This map shows the earth divided into eight sectors, 45 degrees wide, centered on zero degrees longitude. Used with Table 1, it reflects the philosophy of the proposed eight sector plan.



This is only a preliminary plan to show the philosophy behind the allocation of the sectors. Fig. 3 defines this plan more clearly. Here two tracks of Phase III are shown, with their apogees separated 45 degrees apart. The right circle depicts the 6000 km range (corresponding to 30 degrees elevation) at the time the first pass is at apogee. The left circle indicates similar range when the apogee is 45 degrees to the west. It can be easily deduced that as long as the apogee of the satellite is located within the indicated 45 degree sector, all stations inside the area of the two overlapping circles will see the satellite at least 30 degrees above the horizon. It can be noticed also that the bulletin transmission can be extended up to three hours after apogee without the loss of the range of coverage. This is based on the fact that the range three hours after apogee is essentially identical to that at apogee. Transmission of bulletins prior to one hour before apogee is not recommended because during that time the earth track follows a relatively flat east-west path and extends outside the range of the overlapping circles.

With the increase of the angle of the argument of the apogee the track will change its shape, allowing bulletin transmissions during three hours before and after apogee. On the other hand, after about three years, the track will "reverse" itself, allowing reliable bulletin transmissions during three hours before but not after, apogee.

If the primary bulletin transmissions are limited to only two hours, as stated earlier, the system will remain permanent and reliable regardless of the angle of argument of apogee, therefore, no periodic readjustments will be necessary.

SECTOR	PRIMARY "SERVICE AREA"	PRIMARY LANGUAGES
1 0 Degrees Plus or Minus 22.5 Degrees	Eastern, Central and Northern Europe West Africa	English, French German, Italian Spanish, Swedish other Scandanavian
2 45 Degrees Plus or Minus 22.5 Degrees	Portugal and Northern Brazil	Portuguese
3 90 Degrees Plus or Minus 22.5 Degrees	United States, Canada Central America, Caribbean Area	English, Spanish French
4 135 Degrees Plus or Minus 22.5 Degrees	Western United States, Hawaii Western Pacific	English, French
5 180 Degrees Plus or Minus 22.5 Degrees	Central Pacific	English, French
6 225 Degrees Plus or Minus 22.5 Degrees	Japan, Australia, Far East Western Pacific, Philippines	Japanese, English Russian, Spanish Korean
7 270 Degrees Plus or Minus 22.5 Degrees	Central U.S.S.R., India Southeast Asia	English, Russian Malasian, Indonesian Languages of India
8 315 Degrees Plus or Minus 22.5 Degrees	Eastern Europe, Middle Africa West Africa	Swahili Polish, Russian Romanian, Yugoslavian Czechoslovakian, Arabic Hungarian, English

TABLE 1.

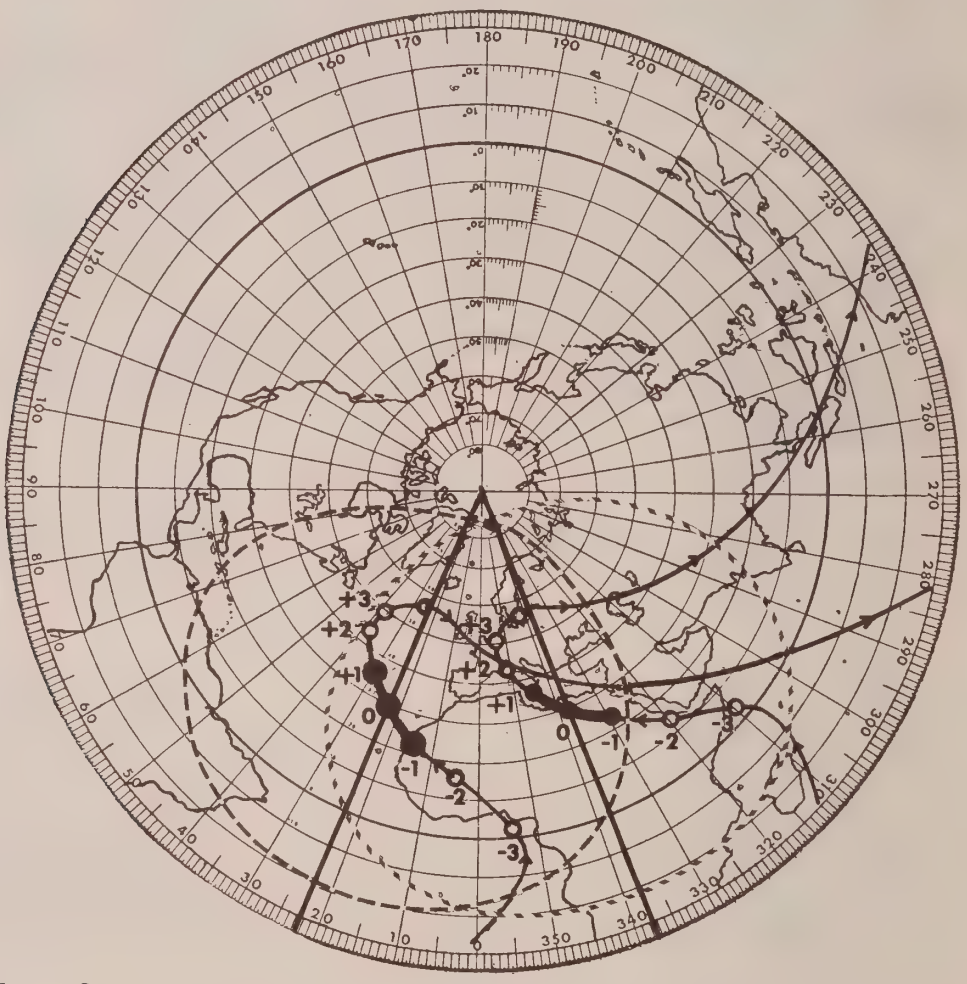
This table, when used with the Polar Projection map(Fig. 2) will more clearly define the "Service Area" countries and languages involved with each of the eight sectors.

It can be noticed, by examining Fig. 2, that bulletin stations located in the overlapping service area can actually serve two such areas. Taking this into account , it may be possible to cover the majority of the populated areas of the northern hemisphere with only three bulletin stations, (Fig. 4) located, for example, in Budapest, Southern California and Tokyo. Although feasible, this arrangement would place a heavy burden on the bulletin stations. It appears that the eight sector plan might be the most efficient and convenient alternative.

The Phase III satellite is not sun-synchronous; therefore, its apogee may occur at any time during the day or night at intervals of approximately 10 hours 45 minutes and separated about 164 degrees in longitude. This implies that each service area will be able to receive the bulletin at rather irregular intervals, sometimes up to five days apart. Orbital predictions will be available that will indicate the exact location and the time of the apogee during each orbit.

FIG. 3

6000 kilometer range of Phase III, at apogee. Within this circle, the satellite will be visible at least 30 degrees above the horizon. Also shown are two tracks of Phase III, with their apogees 45 degrees apart. (See Note below).


-1 -2 -3 - Track of the satellite with hour after, or before, apogee indicated.
- First orbit
- Second orbit, 45 degrees further to the west.

NOTE: The orbital tracks shown are not consecutive orbits. They show only the most Eastern and most Western tracks possible in a "Sector".

Since it appears unlikely that each major linguistic area can support its own bulletin station, it will be necessary for several neighboring countries to make an arrangement which would allow airing of bulletin tapes of different languages from a common station.

Although only one station per service area would be most desirable,two such stations can easily be accommodated, as long as the time sharing arrangement is agreed upon. For example, one station might transmit for one hour before the exact time of the apogee, and the other for one hour thereafter.

For channel management, it is proposed to appoint General Bulletin Channel coordinators in each of the eight sectors. Each manager would be responsible for appointing bulletin stations from the various interested countries within the sector. This person will also be responsible for scheduling and coordinating time slots for the bulletin transmissions within the sector. This essential task will be a bit complicated, as the satellite position varies each day from orbit to orbit. In other words, it will not be possible to assign a fixed time or orbit each day for a particular station as is now done on the Phase II satellites. Rather, a schedule will be required based on a longitudinal crossing point and elapsed time as measured from apogee. Each station will be assigned a time slot within the sector and will transmit the bulletins when the satellite is in the assigned time slot. We should be aware, though, that Phase III orbits will be continually changing as the apogee will shift gradually, from 26 degrees to a maximum of 57 degrees north latitude, and then toward the southern hemisphere. It should be pointed out that stations in the southern hemisphere will look at the satellite in a better than Phase II orbit situation for the first few years. Bulletin stations in that hemisphere will continue operations much the same as our present day Phase II operations.

We wish to stress here that this proposed eight sector plan is geared for prime bulletin channel time, that is, an hour before to three hours after apogee. There is no reason why this channel cannot be used from the time the satellite rises (just becomes visible) until it sets (loss of signal). Indeed, it will be a smart channel manager who utilizes the channel for maximum bulletin time. Ideally, bulletin stations will be required capable of tracking accurately and able to access the transponder when the satellite is rising and setting.

In conclusion, an enormous amount of work will be required by the committee before launch, presently scheduled for late in the first quarter of 1980. We are, therefore, at this time soliciting ideas, queries and feedback of any nature from the many satellite users and amateur radio societies throughout the world. We shall require this information before the end of the last quarter of 1979. In particular, volunteers will be needed for the role of General Bulletin Channel coordinators in each of the eight sectors, and of course, bulletin station volunteers from all of the participating countries in each of the sectors. Please address your letters to Richard Zwirko, K1HTV, AMSAT Vice President-Operations, c/o AMSAT, Box 27, Washington, D.C. 20044.

ADDITIONAL NOTES

1. With the 8-Segment system, stations within each "service area" would have schedules of the bulletin transmission published in advance, which would include the time and sub-satellite point of the apogee. (No elaborate tracking is necessary.)

2. Educational transmissions could use the same plan. Since the satellite is virtually stationary near apogee, no "following" with a steerable antenna is necessary. This simplifies ground equipment, particularly antenna systems (schools, field demonstrations, etc.)

3. Knowing the sub-satellite point at the apogee, the azimuth of the antenna can easily be determined from a globe, or equi-distant azimuth projection map of the area. (The elevation can be adjusted until the strongest signal is obtained.)

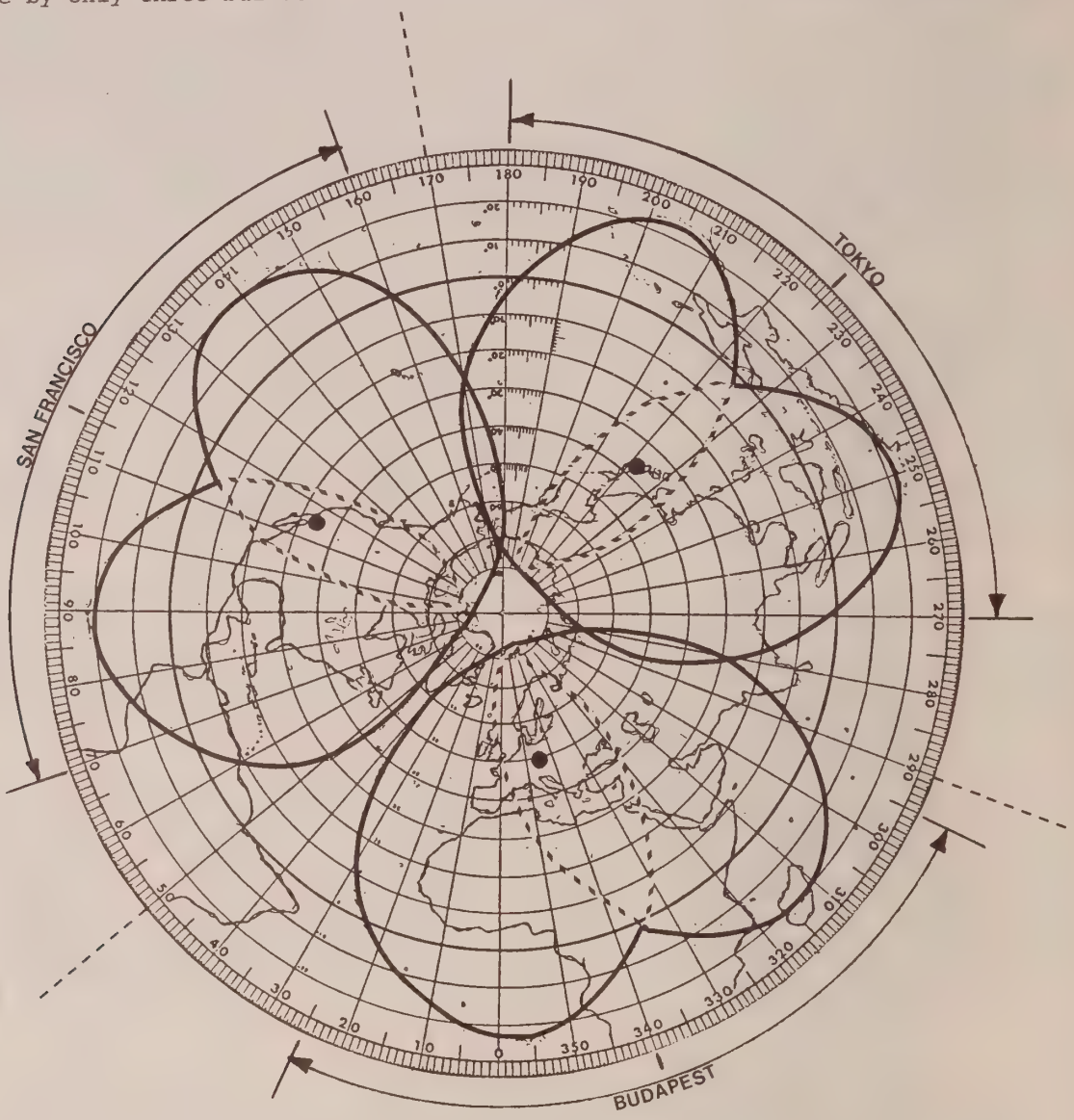
4. Each national society can publish, in advance, the times of bulletin transmissions, including beam headings from various geographical locations within the country (This would only apply to very large countries, U.S.A., Brazil, U.S.S.R., etc.)

5. Once the prospective bulletin stations commit themselves, the "service areas" can be rearranged for best coverage.

6. Non-official bulletin transmissions can be scheduled, by pre-arrangement with the sector coordinator, just before or after the two-hour bulletin slot.

FIG. 4

It is possible to cover the majority of the populated areas in the northern hemisphere by only three bulletin stations if we locate them as shown below.



7. There should be a coordinating station or society in each "service area". There should also be a coordinating arrangement in the southern hemisphere such as exists with our present Phase II bulletin program.

8. Assigning a sector for each bulletin station will eliminate the ambiguity when a particular station is "allowed" to transmit.

9. Bulletin stations will require transmitting equipment on the order of 100 watts output on 435 MHz and should also possess a good circularly polarized antenna system with azimuth-elevation capabilities.

THE INCURABLE OSCAR FEVER

By the XYL of Frank, K9CIS
(Hilda Wisenmeyer)

You may be wondering just what is this disease called OSCAR Fever. I think most XYL's of OSCAR enthusiasts would say it is contagious and very addictive.

I remember in the beginning when my husband was a normal ham operator. (We shall just call this OSCAR fever victim Frank because he isn't at all cured yet.) Frank would only get on 10 meters when the band was open or when he felt the need for a little diversion from grading his students' papers. In fact, his main interest was TV DXing which the whole family enjoyed. It was Christmas, 1977, when Frank was first bitten by the OSCAR bug. I make the mistake of giving him a little innocent looking book called "OSCAR" written by Stratis Caramanolis. On Christmas night I noticed something wrong with Frank. It was 10:30 and he was fervidly reading his new book. I felt pretty proud of myself for buying such a good gift. But the next day I started changing my mind. The OSCAR book came to breakfast with Frank and he would only take a bite of his pancakes when he turned a page of his book. This was very unusual because usually his eyes were too closed to even get to the breakfast table without stumbling around--but here he was reading! It was a good thing Frank was on his Christmas break because he spent the whole rest of the day with his nose in that book. He was finished by evening and I thought that was the end of OSCAR and on to the bookshelf with the rest of his books--but no! The next week was spent talking only about OSCAR. I would say "How's the weather?" and his reply was "Did you know OSCAR circles around the earth every two hours?" Well, I could see that his condition was worsening. The fever seemed to affect the brain-everything was OSCAR this and OSCAR that. He found out about some OSCAR slides and narrated tapes from Bernie at ARRL Headquarters and he immediately sent for them. Never again will family slides be shown when we have any company but only the OSCAR slides. There were also changes being made to his ham radio and the ordering of new antennas but not the familiar TV antennas from Jerrold and Winegard but new places such as Cushcraft and KLM for OSCAR. These antennas would go up and down and round and round. I thought, "He must be bananas." How can anyone talk to a little box flying high up in the sky? I soon found out. First, it was just wanting to listen to OSCAR but soon that wasn't enough. I could see that my husband was becoming addicted to OSCAR and craving more and more. The need to transmit was evident. More rotors, more antennas and preamps and a little map called an OSCAR-LOCATOR to compute when the "bird" (another name for OSCAR) would come around.

The whole family was seeing less and less of Frank because now there were 2 OSCARS (7 & 8). He wouldn't be in bed in the morning when I awoke but if I listened carefully, I could hear our old friend OSCAR beeping away. Then up to wash his face and order breakfast to be sent down to the radio room of course! Then off to teach and home in the evenings for more OSCAR passes and the XYL once again went to bed alone because OSCAR hadn't turned in yet.

Finally came the winter of 1978. Our Midwestern winters are very unpredictable and right away we had an ice storm. I was overjoyed. The OSCAR antennas had frozen right in the overhead position and all the rocking back and forth with the rotor controls could not jar off the ice buildup on the rotors and antenna. He immediately tried having the XYL point an extra OSCAR antenna out the basement window, scanning the skies for the bird. I was glad that brainstorm was a failure because my arms got tired. I thought for sure life would now return to the "good old days" and Frank would finally come out of the basement to join the family again. The powers of OSCAR were too great. Frank was now stricken with deep depression and grief. Armed with his climbing belt, hammer, and extra long extension cord and a Conair hand-held hair dryer, Frank ventured out into the bitter cold to unthaw his antennas. After hours of inching and picking his way up the tower, he finally reached the 10 meter beam and knocked the ice off, but the roof was still too slick to climb over to the chimney where the frozen OSCAR antennas were located. So all he could do was to listen to the Tuesday night AMSAT Net. Then just when he thought he would never be able to hear OSCAR's beeps until the spring thaw, he had an idea which involved me again, the XYL. Should I humor him along since he was so depressed? I decided in the affirmative. Frank lassoed the antennas and gently pulled while I rocked the rotor controls back and forth. I heard a scream from outside and when I peeked out the window, there was Frank jumping up and down yelling "It works, it works --when is the next OSCAR pass?" Well, at least he wasn't down in the dumps any more. Winter finally ended and I had no idea when this fever would go away. I had high hopes for Spring, you know, when man's thoughts turn to fanciful things and away from OSCAR. But alas, Frank had the fever worse than ever. Spring to him meant warmer weather and more antennas for experimenting, more equipment and just more OSCAR. Oh my, it seemed that OSCAR was in complete control

(Continued on Page 35)

A MODE J HELIX

By Bill Allen W7US
8925 E. 5th St.
Tucson, AZ 85710

This helix, when designed by the author, was originally conceived for transmitting on the AMSAT-OSCAR 7 Mode B uplink. The antenna worked extremely well, resulting in less uplink fading than linear polarized antennas, including crossed yagis carefully balanced.

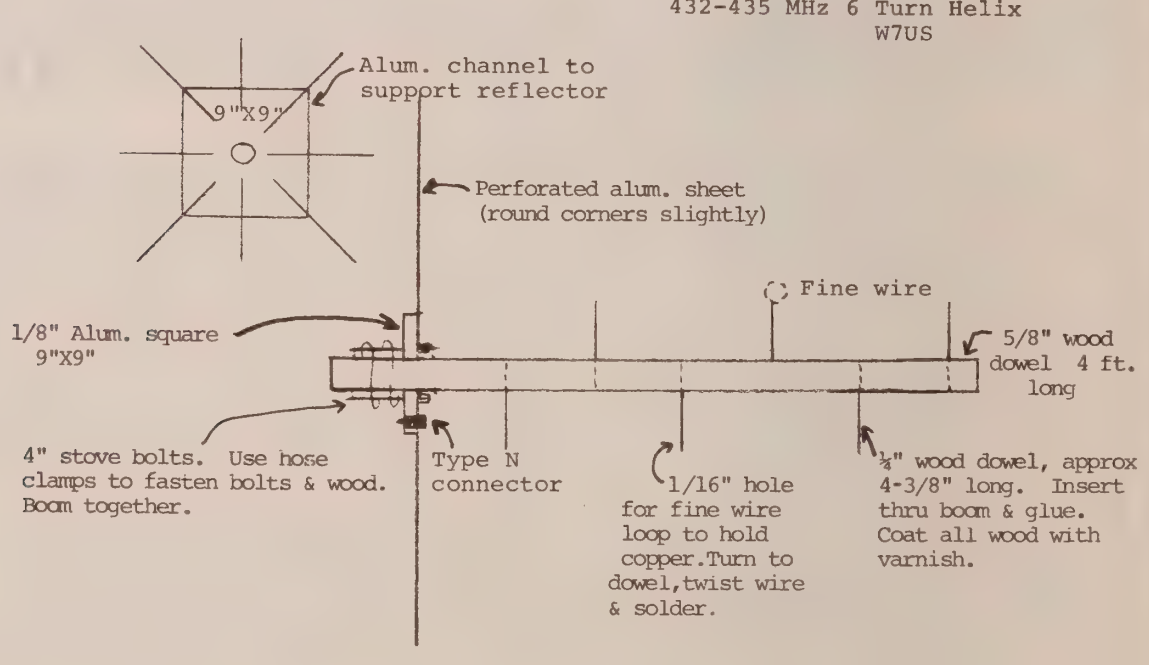
When AMSAT-OSCAR 8 Mode J came into being, it was discovered that this antenna could "hear" Mode J really well. To confirm the performance of the helix, four-element, seven-element, and fifteen-element quagi antennas were tried. The larger quagis provide higher gains of course, but also present tracking problems on fast moving OSCAR 8. None of these antennas could perform as well as the helix. An eleven-element linearly-polarized horizontal yagi was also tried, my original Mode B antenna. This antenna did very well on the horizon shots but suffered very badly from downlink fading above 20 degrees.

An eight-turn helix was also tried but, although furnishing a little more gain, it also reduced the beamwidth so that tracking Mode J was more difficult. An eight or ten-turn helix probably will be excellent for Phase III.

The electrical design is standard, so the author takes no credit for reinventing the wheel; however, the unusual matching system is simple, provides a low VSWR, and works every time. I used whatever coax connectors I had on hand, nothing special. If you are fortunate enough to have all type "N" connectors on hand, so much the better; I didn't.

The mechanical construction is simple and strong. KØSMI built this antenna and it has gone through the Wichita, Kansas winter with no problems, and if you have ever worked Hank, you know he hears all on Mode J.

The author wishes to thank the many Mode J operators who expressed interest in this antenna and prompted me to sumbit it to the AMSAT Newsletter.


432-435 MHz 6 Turn Helix
W7US
Alum. channel to support reflector
9"X9"
Perforated alum. sheet (round corners slightly)
Fine wire
1/8" Alum. square 9"X9"
5/8" wood dowel 4 ft. long
4" stove bolts. Use hose clamps to fasten bolts & wood. Boom together.
Type N connector
1/16" hole for fine wire loop to hold copper. Turn to dowel, twist wire & solder.
¼" wood dowel, approx 4-3/8" long. Insert thru boom & glue. Coat all wood with varnish.

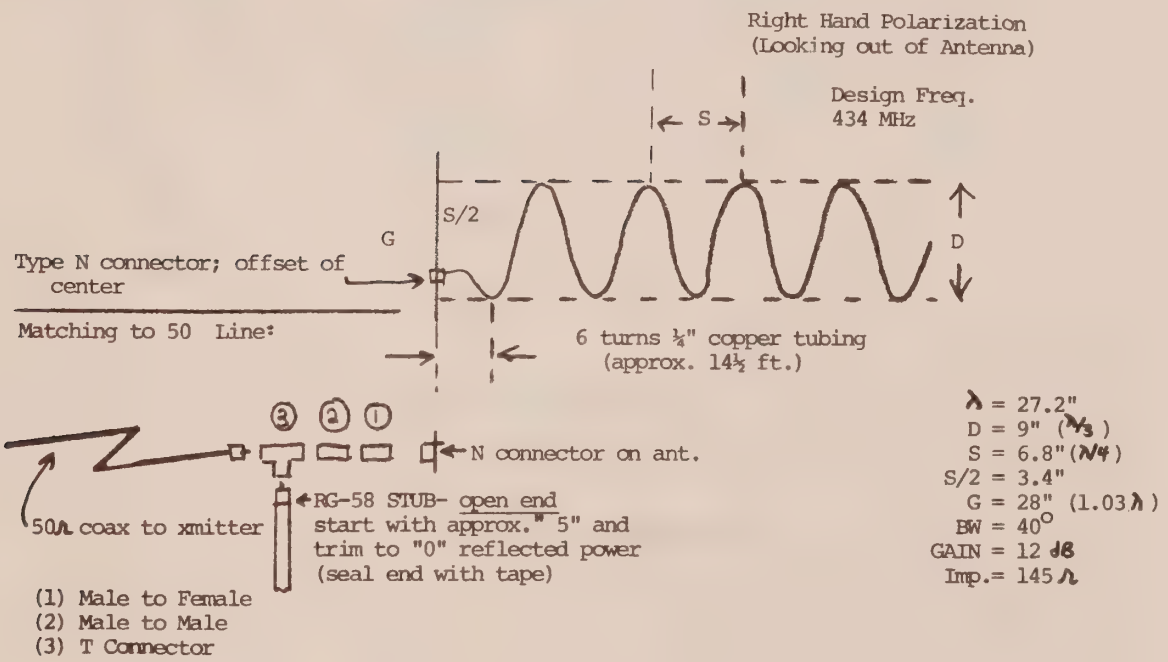
(Continued from Page 13)

The method I use was developed by William P. Overbeck of Aiken, S.C., and was very adequately described in two booklets issued by the Volunteer Satellite Tracking Program in 1960. The title of the books are "A Letter to Gregory Roberts" Part I and II, and in this publication Bill described his prediction technique -- which I use to this day -- as well as the interpretation of observations and orbit determination. Unfortunately I do not know if this publication is available now as the last information I had was that the Volunteer Satellite Tracking Program changed its name to the Independent Tracking Coordination Program under Norton Goodwin and was issuing predictions under the code ZIPSAT for a small cost,to interested bodies. I have not done any serious orbit determination by optical means since 1968, when I became a professional astronomer and considered that I did enough night work, without adding satellite tracking in my spare time.

Perhaps one day I will get the desire to do my own orbit determination for the amateur satellites -- I am confident that a careful orbit determination will be just as accurate, or better, than any of the predictions currently available to amateurs.

To conclude, it is interesting to note that this is not the first time that amateur satellites have been confused. In 1965 I was involved in an optical tracking effort to sort out the nine objects launched with 1965-16. One of the objects was OSCAR 3. OSCAR 7 was initially misidentified with Intasat, a Spanish satellite on the same launch, and we all recall OSCAR 8 being confused with the launch vehicle for several months. Now we have RS 1 and RS 2. In all these cases I feel that optical observations would have resolved the problem with little trouble. The Phase III satellites will provide a most interesting situation for orbit determination by optical tracking, so it looks like I'll have to get my big telescopes ready for this!

PS: On the case of 76-47A, P76-5. This satellite has a nice strong AØ carrier on 137.680 MHz besides the ones on 70 cm and 23 cm. The former I picked up a few days after the satellite was launched and this was a doppler orbit determination.



SATELLITE COMMUNICATIONS COVERAGE MAPS

By Bill Johnston, N5KR

Over the past few years, quite a large number of the people who have written to me requesting the perpetual orbital prediction printouts for the OSCAR satellites have also inquired about other types of operating aids. One of the most frequent requests has been for some type of map that would show all the areas with which communication through a given satellite is possible. Such a map would simply show all of the areas that could be contacted at one time or another, though, clearly, not all of the potential areas would be accessible on a single pass. In theory, this can be accomplished just by obtaining an existing map, then drawing a line around your QTH at a constant distance corresponding to the maximum communications range through the satellite.

Figure 1

The problem encountered is that on almost all map projections the distance scale is not uniform when measuring outward in different radial directions, so just drawing a circle around your QTH can easily result in errors equivalent to several hundred miles in some directions. The only kind of map (other than a globe) which is entirely satisfactory for this use is an azimuthal equidistant ("great circle") projection which has been prepared using your station location as its center.

Figure 2

46:22N 6:01E
AZIMUTHAL EQUIDISTANT PROJECTION PREPARED BY WILLIAM D. JOHNSTON

Until recently, such maps were available centered on only a few of the largest cities in the world. Several months ago, however, I completed work on a computer program and data base which permits the computer to actually draw an azimuthal equidistant world map centered on any desired location. The finished map measures 11 x 14 inches (28 x 35 cm), and requires that the computer make the appropriate trigonometric calculations on nearly 20,000 data elements. A typical map is illustrated in Figure 1.

Although these maps were originally designed to provide beam headings for DX work, they can serve double duty if you add satellite communications range circles. On this type of map you simply use a compass to draw a perfect circle of the appropriate radius for each satellite. (The compass can be set to the proper radius using the supplied distance scale.) The applicable radial distances are as follows: OSCAR 8, 3997 miles (6433 km); OSCAR 7, 4898 miles (7883 km); RS- 1 & 2, 5226 miles (8411 km).

I also prepared another version of the computer program which draws maps expressly for the purpose of displaying satellite communications coverage. See Figure 2 for an illustration of one of these maps. Here again an azimuthal equidistant projection is used, but most of the areas that are beyond the maximum range of the satellites have been omitted from the map. This permits us to expand the scale of the area that we are interested in and thereby see more detail. Also, meridians and parallels have been added for reference, and the communications range circles for all of the currently operational satellites have already been drawn in by the computer. (The finished map size is 11 x 11 inches, or 28 x 28 cm). These features make this version of the map more suitable for OSCAR use, but it can no longer be conveniently used for DX beam headings. Note that neither version shows antenna tracking information; both are simply meant to display the potential areas with which communication is possible, not to show when the communication can occur.

Arrangements have been made to have these custom made computer-drawn maps produced for any interested hams. Since the maps are made in batches, and the work is done out of town, it takes about two weeks plus the usual time in the mail. If you are interested in having one of these maps made for your own QTH, you will need to send the following:

1. Name and mailing address.
2. The location you want the map centered on.
3. The type of map you want. (DX beam heading style, or special communications coverage style.)
4. If you request the DX beam heading style, specify the call letters that are to be put at the top of the map.
5. Payment to cover the cost of computer time, plotter time, and postage, as follows:

   DX beam heading style:

   $5.00 postpaid via 3rd Class Mail, worldwide.
   $5.75 postpaid via 1st Class Mail, U.S.A., Canada, Mexico.
   $6.50 postpaid via Air Mail, worldwide.

   Special communications coverage style:

   $4.25 postpaid via 3rd Class Mail, worldwide.
   $5.00 postpaid via 1st Class Mail, U.S.A., Canada, Mexico.
   $5.75 postpaid via Air Mail, worldwide.

6. Send the above to:

   Bill Johnston, N5KR
   1808 Pomona Drive
   Las Cruces, New Mexico 88001
   U.S.A.

AMSAT GRATEFULLY ACKNOWLEDGES DONATIONS OF $100 OR MORE FROM THE FOLLOWING NEW LIFE MEMBERS

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LM-1049 Raymond Saidah, OD5AO/FØDDA
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LM-1065 Carter Pfaelzer, W1TCD
LM-1066 D.R. Amos, WD8AOL
LM-1067 Joseph C. Morris, WB4ZMP
LM-1068 Robert Kegan, W8BCF
LM-1069 John J. Champa, K8OCL
LM-1070 George Buchanan, K2ON
LM-1071 Louis N. Anciaux, WB6NMJ
LM-1072 James P. Taylor, K9JT
LM-1073 L.S. Wells, K4FFN
LM-1074 Walter Henry, W6ZN
LM-1075 Teruyuki Fujinara, JA4CMJ
LM-1076 Lee V. McKinnis, Jr., K9EY

ANNOUNCEMENT OF AMSAT ANNUAL MEETING

The eleventh AMSAT Annual Meeting will be held at 8:00 P.M. on Saturday, October 6, 1979 at the NASA Goddard Space Flight Center Employee Recreation Center in Greenbelt, Maryland.

In accordance with the AMSAT Bylaws, ballots for the election of four Directors and two alternate Directors will be counted at this meeting. The terms of the following Directors will be expiring as of this meeting: Jan King W3GEY, Perry Klein W3PK, Randy Smith VE3SAT and William Webster WB2TNC.

The agenda, in addition to the election and regular business, will include:

AMSAT Annual Report

AMSAT-Canada SYNCART Project Progress Report

AMSAT Phase III Progress Report

AMSAT-OSCAR 7 and 8 Operations

Results of election of Directors

An open house will be held at our new AMSAT-OSCAR Spacecraft Laboratory located at the Goddard Space Flight Center Visitor Center at 3:00 P.M. This will be an opportunity to see satellite hardware and ground support equipment, and will be followed by a tour of the NASA Goddard Space Flight Center.

For those coming from out of town, let us know, and we will try to arrange for you to be hosted by Washington area AMSAT members.

DIRECTIONS TO THE NASA GODDARD EMPLOYEE RECREATION CENTER:

Take the Baltimore-Washington Parkway to the Greenbelt Road exit (Rt. 193), and take Greenbelt Road east 1.5 miles to Soil Conservation Road (on the left). Turn left onto Soil Conservation Road and go 0.1 mile to the first open gate you come to on the right. Go through this gate, continue onto the gravel road and then on to the wooden Goddard Recreation Center building.

There will be an AMSAT dinner before the meeting at 6:00 P.M. at the Goddard Employee Recreation Center. Please let us know if you can join us so that we can firm up reservations.

The 146.25/85 AMSAT repeater will be available for talk-in before the dinner and the meeting.

(Continued from Page 29)

of Frank now. For example, whenever we made any trips to the grandparents who live in another city, Frank had to check with OSCAR before we had even left to make sure we got back home in time to hear the bird. Also, Frank decided OSCAR passes just weren't long enough so he borrowed his mother's cherished tape recorder, not to tape the grandchildren's sweet voices as his mother was led to believe, but just so he could record an OSCAR pass and play it back later when the bird was out of range. So now when I turn in for the night I wonder is it Memorex or the real OSCAR beeping away from our bed. Then there are the strange little notes that mysteriously appear in the evening taped to the bathroom mirror with times such as 7:23 TCA and 7:34 LOS telling the first orbits of the following morning. Does the OSCAR Fairy do this to the mirror or is it just another result of Frank's OSCAR Fever?

Finally, Frank decided that he should write an article to the AMSAT Newsletter, which would spread the fever to whomever read it. But guess what, he is having the hardest time finishing his paper because he is too busy listening to you know who. I thought it was my duty as an XYL to write and warn you of the dangers and consequences of OSCAR Fever before you ever read his article. Many of you have probably already contracted this dread disease affecting OSCAR enthusiasts but there may be hope for some and their XYL's. As to the future of Frank's condition, who knows? I can only hope that someday he will be able to kick the fever but for now he is under the power of OSCAR.

NOTICE OF 1979 ELECTIONS

Four positions on the Board of Directors of the Radio Amateur Satellite Corporation (AMSAT) are to be filled at an election to be held at the October 6 Annual Meeting at the Employees Recreation Center, Goddard Space Flight Center, Greenbelt, Maryland. Mail ballots should be sent to AMSAT Elections, Box 27, Washington, DC 20044 so as to arrive before October 6th, 1979. Be sure to put your name, membership number and zip code (for U.S. members) or country (for members outside of the U.S.) on your mailing envelope so that your vote can be validated.

The biographical information supplied by or on behalf of the various candidates varied considerably. The following information is thus provided about each of the candidates so as to enable you, as a member, to decide which four (4) to give your vote to.

Edward J. Bizub (WA2CBB)

Has been involved with AMSAT and the amateur satellite program for more than five years. He has been Area Coordinator for New Jersey for several years and has given numerous presentations and demonstrations of OSCAR to classrooms and radio clubs. He is also a member of the North Jersey DX Association. Professionally, he is manager of Special Projects for ITT Mackay Marine and is involved in the sale of communication and navigation equipment for the big ship marine industry. He is a member of the IEEE and the Society of Naval Architects and Marine Engineers.

John S. Browning (W6SP)

Is Vice President of the Southern Ca. DX Club and a former President of the Northern Ca. DX Club. He has served as Director for Project OSCAR for the past four years. He is active at HF, VHF and UHF. He has operated amateur radio stations from a number of countries and is a life member of ARRL. Professionally, he is Systems Program Director for International Communications Satellites, Air Force Space and Missile Systems Organization (SAMSO) holding the rank of Colonel. He is a Director and Coordinator of L.A. area Armed Forces Communications Electronics Association (AFCEA) and founding President of the Santa Clara Chapter.

John M. Henry (VE2VQ)

Served as President of CARF (1977-78), Vice President of CARF (1976-77) and served as a director of the Ottawa Amateur Radio Club (1972-74). John is also President and Project Coordinator of AMSAT-Canada. John was active in providing support to the OSCAR 6 Command Station at VE3QB. He has given numerous OSCAR demonstrations. Professionally, John is a Systems Engineer with TELESAT Canada, responsible for all Earth Station Communication Equipment.

Jan A. King (W3GEY)

Has served on the Board of Directors since the founding of AMSAT in 1969. He is currently serving as Vice President for Engineering, and as Project Manager for the Phase III project. He also served as Project Manager for the OSCAR 5, 6 and 7 spacecraft (i.e., without him, there would have been no spacecraft). Professionally, Jan is a Member of the Technical Staff at the NASA Goddard Space Flight Center.

Perry I. Klein (W3PK)

Has served as President and member of the Board of Directors since the founding of AMSAT in 1969. He helped develop the 2/10 meter satellite transponders flown on AMSAT's OSCAR 6, 7 and 8. He has been employed by AMSAT since 1973, first as Engineer and later as General Manager. He served as President of the University of Pa.Radio Club and as President of the COMSAT Amateur Radio Club. Perry is responsible for all aspects of the day-to-day operations of the AMSAT organization.

Jim McKim (WØCY)

Presently is serving as the AMSAT Mid-Continent Net Control and as AMSAT Area Coordinator for Kansas. He is a life member of ARRL, OOTC and QCWA. He was

Midwest Amateur of the Year in 1975 and Kansas Amateur of the Year in 1978. He was organizer and first President of the Central Kansas Amateur Radio Club of Salina. He has served as an Assistant Director of the ARRL since 1957 and served two terms as Vice-Director --Midwest Division of the ARRL. Professionally, he is President, ELECTRONICS, Inc., Salina, Kansas. He is a member of the Kansas Engineering Society and Smoky Valley Chapter.

Domenico Marini (I8CVS)

Serves as Space Activity Coordinator for the Associazione Radio Amatori Italiani (ARI) and writes a monthly column in the Italian national magazine, Radio Rivista. He also serves as the AMSAT Area Coordinator for Italy. He is a member of AMSAT-Italiana and AMSAT-UK. He is also involved in 432 MHz E.M.E. activities. Professionally, he is an Electronics Engineer in the Metallurgy industry.

Piero Moroni (I5TDJ)

Serves as Technical Director for AMSAT-Italiana. He has been involved in a number of activities and designed a new 2/10 transponder (written up in the AMSAT Newsletter) having a three passband IF stage so as to minimize the desense effect of high power users. Several of his technical designs have been published in Italy and one was translated and published in Ham Radio magazine. He is also involved in 432 MHz moonbounce activity. Professionally, he is an Electronics and Radio Engineer with one of the largest electronics manufacturers in Florence.

William J. Webster, Jr. (WB2TNC)

Serves as manager of the AMSAT Communications Nets and is usually heard at WA3NAN every week. Will maintains orbital information for current satellites, analyzed the orbit of AMSAT-OSCAR 8 and provides predictions to telecommand stations. He is also principal instructor for Novice Classes at the Goddard Space Flight Center Amateur Radio Club. Professionally, he is a member of the Technical Staff at the NASA Goddard Space Flight Center.

BALLOT SHEET

Vote for up to four (4) candidates and mail to AMSAT-Elections, Box 27, Washington, DC 20044. U.S.A. Ballots must be received by October 6th, 1979.

IMPORTANT - Be sure to include your name, member number and zip code (or country, if not in the U.S.) on the envelope containing your ballot so that it can be validated.

( ) Edward J. Bizub WA2CBB

( ) John S. Browning W6SP

( ) John M. Henry VE2VQ

( ) Jan A. King W3GEY

( ) Perry I. Klein W3PK

( ) Jim McKim WØCY

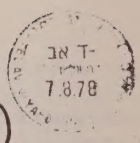
( ) Domenico Marini I8CVS

( ) Piero Moroni I5TDJ

( ) William J. Webster, Jr. WB2TNC

VOTE FOR ONLY (4) FOUR!!

Letter and Comment



Dear Joe:

Mr. Hank Fitz, WB4URU, gave a presentation on the satellite program at our club's April meeting. It was very interesting and answered many questions. There were eighteen Novices at the meeting and along with others who had no idea what AMSAT was. We now know. Thank you for the photographs and charts used in the presentation.

There will probably be a few more signals from N. Florida to our "Ham Eye in the Sky." Good Luck.

Very truly yours,

Ed Palagyi, WB4QVK
Sec. NOFARS

Dear Mr. Kasser:

I have been interested in your AMSAT satellite network ever since I read "The Sky's The Limit" an article written by you in the November, 78' issue of BYTE (magazine).

I own a SOL-20 microcomputer, and was interested in connecting it via a phone line (via an acoustic modem) into your network. I would appreciate it if you would send me more information on the network such as how I can use it (connection), where is the closest network (repeater), cost, and other information on the network and languages, etc.

Thank you very much.

Very truly yours,

Jonathan Lanigan
260 S.W. 18th Ct.
Pompano Beach, FL

(Any Florida member who can help Jonathan, please contact him --Joe)

Dear Joe,

I'm happy to announce that I have obtained for Muskingum Tech College, here in Zanesville, Ohio, a grant of $7,181 from the National Science Foundation for a 24-month project entitled "Communications Satellite Supplement for Technical Physics". The goal of this project is to develop educational materials suitable for technical college students, utilizing amateur satellites.

My plans are to set up a portable station using an ICOM IC-701 and a 70 cm converter for a receiver, and an ICOM IC-202S with a 2 meter linear amplifier and home-brew helical antennas for transmitting. Sound O.K.? I would like to operate Mode J as much as possible.

I plan to use the portable station to give demonstrations at schools throughout the area. I have experience at educational technical writing, so perhaps I can be of some help to the AMSAT effort after I get set up and operating.

I have been listening to the satellites on Mode A for about a year now. I wrote my own program to compute OSCAR orbits using a TI-58 programmable calculator and it works fine.

This morning, just before 8:00 AM class, I talked to WB6AZP, who was traveling with WB8LUS on the way to the Dayton Hamvention. I hope to meet some of the AMSAT people soon, and I plan on attending the Oct. 6 meeting at Goddard.

73,

Elmer J. Phillippi,
N8AKC

Dear OMs:

I am still set up for 2 m to 10 m on the satellite but don't work it anymore due to poor considerations by AMSAT officials. OSCAR 7 is no good here at all on 2 to 10 and OSCAR 8 is too low for me to work the East Coast of the U.S.

Your area on OSCAR 7 has a 2 min. time till I hose it and that is up to 0^{o} to 90^{o} south bound. OSCAR 8 doesn't have anything at all on it from the East Coast. I don't have any Mode B or Mode J gear and the possibility of getting that type of stuff here is impossible. I can't affort to buy that gear. I went in over my head to get the TS 700 to get on the satellite. Had fun but after OSCAR 6 dies that left us with a bird up there that is useless. Seems to me if one antenna system was so good why was it changed. Are you at AMSAT only thinking of yourselves and a very small clique of amateurs that can get the gear and parts and so forth to get on the satellite? I have tried to get on Mode B by building but I gave up after not being able to find the varactors to go this route and 432 gear on market is up around $700-$800, which is out. Now how does AMSAT & ARRL think that amateurs in other countries which do not have the availability of parts & equipment are to get on the bird. 2 to 10 meter, I can see but the Phase III bird & the other ideas are nice but open only to a very small group of amateurs at this time and will seem to stay that way. I would be glad to rejoin AMSAT only if you quit playing to a group and decide to represent me and other amateurs that only can get the basics together to get on 2 to 10. As you know VHF & UHF are two different games. The parts and circuits are much more critical. These are my feelings and if I had the money I would put an ad in the magazine along side of AMSAT, saying just what I said. There are others that feel as I do for I have talked with them.

I am thinking of taking my antenna down and changing it around for scatter work this summer as soon as weather breaks for I don't see any future here for satellite work even though I am the closest of all KL7 to the East Coast.

If AMSAT would say that another OSCAR 6 type bird was going up soon, I would stay on the bird.

73,

John, KL7IFP

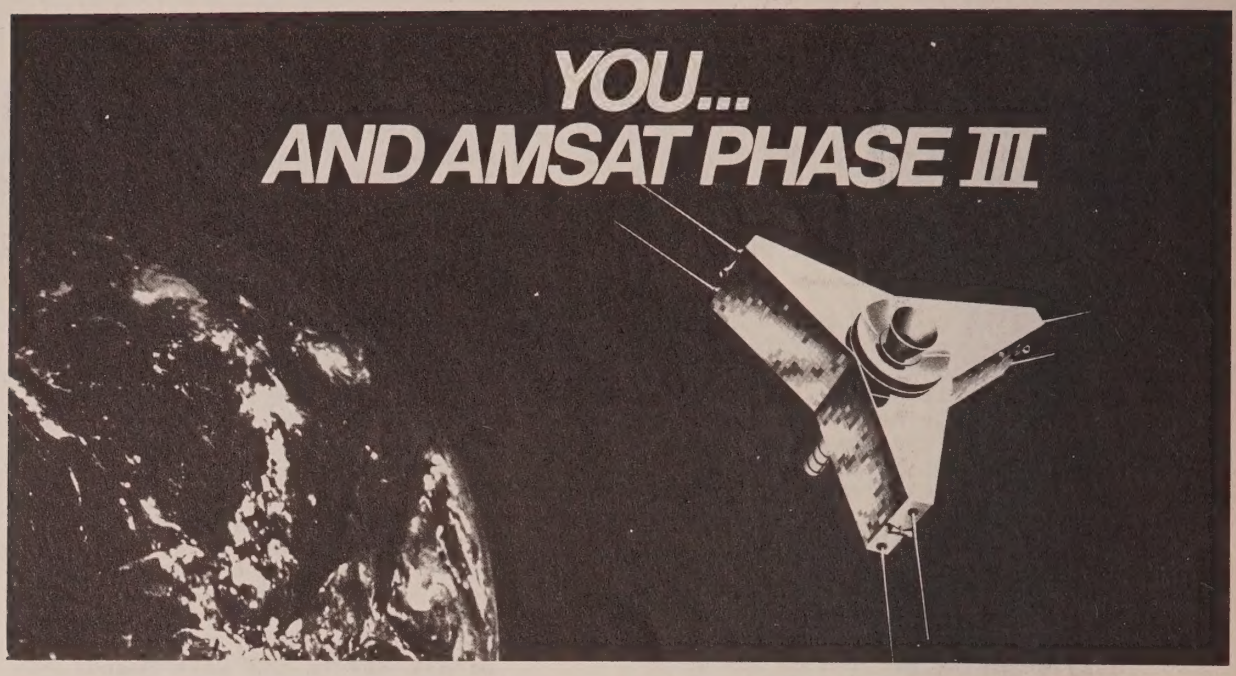
John, the Phase III satellite will give you coverage of the entire Northern hemisphere for up to 12 hours at a time. You will change from a bad QTH to one of the best via Phase III. Varacter triplers are available by mail, advertised in QST and Ham Radio. Have you listened to Mode B (when it was at its best)? Will you not agree that the B downlink is superior to the A?

ORBIT INFORMATION

The following data are presented as an aid to computing orbit tracking information for the various satellites. More detailed information is available in the 1979 Orbital Predictions book and via the AMSAT Nets.

Satellite	Orbit No.	Date (1979)	Time (UTC)	Longitude (^{o}W)	Period (minutes)	Longitude Progression (^{o}W/orbit)
OSCAR 7	20951	June 15	0111.24	81.51	114.9448	28.7376
OSCAR 8	6505	June 15	0057.10	59.13	103.2258	25.8074
RS-1	2772	June 15	0036.51	236.79	120.3894	30.2270
P76-1	15237	June 15	0026.61	192.32	105.70	26.42

YOU... AND AMSAT PHASE III



An exciting new era in amateur radio is about to begin... the era of AMSAT PHASE III OSCAR satellites.

The AMSAT PHASE III satellite program promises a continuing demonstration that amateur radio is at the forefront of modern technology. PHASE III satellites will routinely provide reliable communications over paths of up to 11,000 miles (17,600 km) for 17 hours each day. You can think of them as a resource equivalent to a new band.

The cost of these PHASE III satellites is a projected $250,000. Commercial satellites of similar performance would cost nearly $10,000,000.

Your help is needed to put these PHASE III OSCAR satellites in orbit.

Your valued, tax-deductible contribution can be as small as one of the 5000+ solar cells needed. A handsome certificate will acknowledge the numbered cells you sponsor for $10 each. Larger components of the satellites may also be sponsored with contribution acknowledgements ranging to a plaque carrying your name aboard the satellites. Call or write us for the opportunities available.

Your membership in AMSAT is important to the satellite program, and will give AMSAT a stronger voice in regulatory matters concerned with satellites. At $10 per year or $100 for life, you will be making a most significant contribution to the satellite program and the future of amateur radio. You will also receive the quarterly AMSAT newsletter.

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